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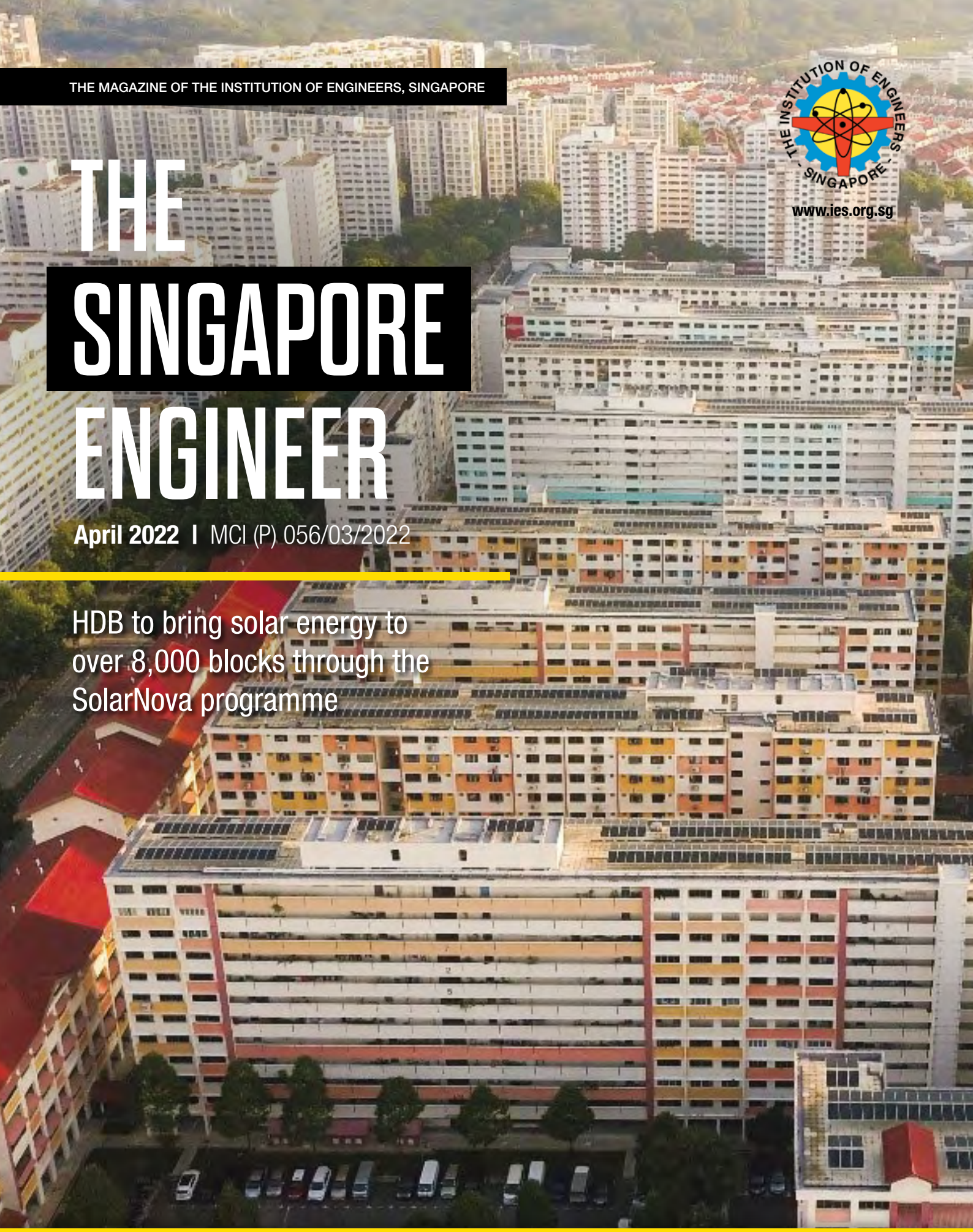

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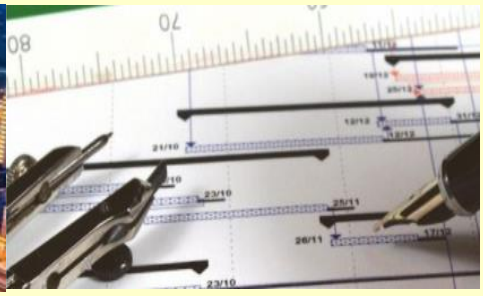

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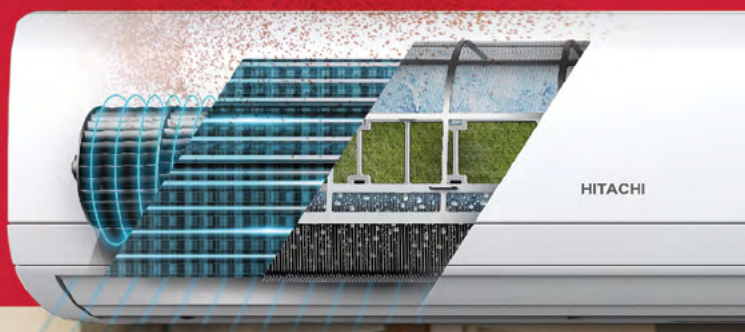
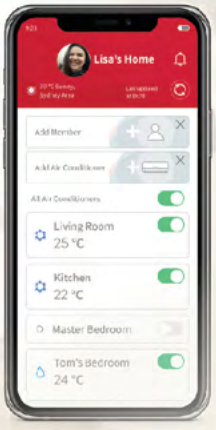


Wi-Fi Control Available via airCloud Home**



Note: Product features may differ according to model.

*Tested by Kitasato Research Centre for Enviromental Sciene. Test No. 2020_0386. Surpress Virus effect observation test by operating FrostWash®. Used model: RAK-35RPE / RAC-35WPE

**airCloud compatibility of wifi adapter varies depending on air conditioner models. The installation of an airCloud Adapter might be required (available as an accessory).Router shall be able to support 2.4GHz band.

Cooling & Heating

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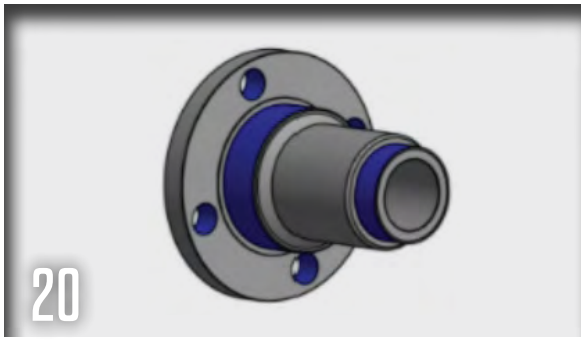

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DIGITALISATION

PROJECT APPLICATION

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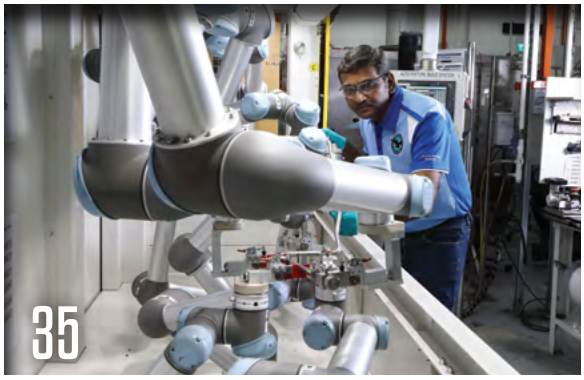


REGULAR SECTIONS

Action taken now can lead to a reduction in emissions

In the period 2010 to 2019, the average annual global greenhouse gas emissions were at their highest levels in human history, but the rate of growth has slowed. But without immediate and deep emissions reductions across all sectors, limiting global warming to 1.5° C is beyond reach. However, there is increasing evidence of climate action, said scientists in the latest Intergovernmental Panel on Climate Change (IPCC) report released recently.

Since 2010, there have been sustained decreases of up to 85% in the costs of solar and wind energy, and batteries. An increasing range of policies and laws has enhanced energy efficiency, reduced rates of deforestation and accelerated the deployment of renewable energy.

"We are at a crossroads. The decisions we make now can secure a liveable future. We have the tools and know-how required to limit warming. I am encouraged by climate action being taken in many countries. There are policies, regulations and market instruments that are proving effective. If these are scaled up and applied more widely and equitably, they can support deep emissions reductions and stimulate innovation", said IPCC Chair, Dr Hoesung Lee.

The Summary for Policymakers of the IPCC Working Group III report 'Climate Change 2022: Mitigation of climate change' was approved on 4 April 2022, by 195 member governments of the IPCC, through a virtual approval session that started on 21 March. It is the third instalment of the IPCC's Sixth Assessment Report (AR6), which will be completed this year.

Options in all sectors

Limiting global warming will require major transitions in the energy sector. This will involve a substantial reduction in fossil fuel use, widespread electrification, improved energy efficiency, and use of alternative fuels (such as hydrogen).

"Having the right policies, infrastructure and technology in place to enable changes to our lifestyles and behaviour can result in a 40-70% reduction in greenhouse gas emissions by 2050. This offers significant untapped potential. The evidence also shows that these lifestyle changes can improve our health and well-being", said IPCC Working Group III Co-Chair, Professor Priyadarshi Shukla.

Cities and other urban areas also offer significant opportunities for emissions reductions. These can be achieved through lower energy consumption (such as by creating compact, walkable cities), electrification of transport in combination with low-emission energy sources, and enhanced carbon uptake and storage using nature. There are options for established, rapidly growing and new cities.

"We see examples of zero energy or zero-carbon buildings in almost all climates. Action in this decade is critical to capture the mitigation potential of buildings", said IPCC Working Group III Co-Chair, Professor Jim Skea.

Reducing emissions in industry will involve using materials more efficiently, reusing and recycling products and minimising waste. For basic materials, including steel, building materials and chemicals, low- to zero-greenhouse gas production processes are at their pilot to near-commercial stage.

This sector accounts for about a quarter of global emissions. Achieving net zero will be challenging and will require new production processes, low and zero emissions electricity, hydrogen and, where necessary, carbon capture and storage.

Agriculture, forestry, and other land use can provide large-scale emissions reductions and also remove and store carbon dioxide at scale. However, land cannot compensate for delayed emissions reductions in other sectors. Response options can benefit biodiversity, help us adapt to climate change, and secure livelihoods, food and water, and wood supplies.

The next few years are critical

In the scenarios IPCC assessed, limiting warming to around 1.5° C (2.7° F) requires global greenhouse gas emissions to peak before 2025, at the latest, and be reduced by 43% by 2030. At the same time, methane would also need to be reduced by about a third. Even if this is done, it is almost inevitable that this temperature threshold will be temporarily exceeded, but the world could return to below this threshold by the end of the century.

"It is now or never, if we want to limit global warming to 1.5° C (2.7° F). Without immediate and deep emissions reductions across all sectors, it will be impossible", said Professor Skea.

The global temperature will stabilise when carbon dioxide emissions reach net zero. For 1.5° C (2.7° F) rise, this means achieving net zero carbon dioxide emissions globally in the early 2050s. For 2° C (3.6° F), it is in the early 2070s.

This assessment shows that limiting warming to around 2° C (3.6° F) still requires global greenhouse gas emissions to peak before 2025, at the latest, and be reduced by a quarter, by 2030.

Closing investment gaps

The report looks beyond technologies and demonstrates that while financial flows are a factor of three to six times lower than levels needed by 2030 to limit warming to below 2° C (3.6° F), there is sufficient global capital and liquidity to close investment gaps. However, it relies on clear signalling from

governments and the international community, including a stronger alignment of public sector finance and policy.

"Without taking into account the economic benefits of reduced adaptation costs or avoided climate impacts, global Gross Domestic Product (GDP) would be just a few percentage points lower in 2050 if we take the actions necessary to limit warming to 2° C (3.6° F) or below, compared to maintaining current policies", said Professor Shukla.

Achieving the Sustainable Development Goals

Accelerated and equitable climate action in mitigating and adapting to climate change impacts is critical to sustainable development. Some response options can absorb and store carbon and, at the same time, help communities limit the impacts associated with climate change. For example, in cities, networks of parks and open spaces, wetlands and urban agriculture can reduce flood risk and reduce heat-island effects.

Mitigation in industry can reduce environmental impacts and increase employment and business opportunities. Electrification with renewables and shifts in public transport can enhance health, employment, and equity.

"Climate change is the result of more than a century of unsustainable energy and land use, lifestyles and patterns of consumption and production. This report shows how taking action now can move us towards a fairer, more sustainable world", said Professor Skea.

Originally scheduled for release in July 2021, the report was delayed for several months by the COVID-19 pandemic, as work in the scientific community including the IPCC shifted online. This is the third time that the IPCC has conducted a virtual approval session for one of its reports.

The IPCC

The Intergovernmental Panel on Climate Change (IPCC) is the UN body for assessing the science related to climate change. It was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988 to provide political leaders with periodic scientific assessments concerning climate change, its implications and risks, as well as to put forward adaptation and mitigation strategies. In the same year, the UN General Assembly endorsed the action by the WMO and UNEP in jointly establishing the IPCC. It has 195 member states. Thousands of people from all over the world contribute to the work of the IPCC. For the assessment reports, experts volunteer their time as IPCC authors to assess the thousands of scientific papers published each year.

Increase in company net zero commitments

New assessments released recently by Climate Action 100+, the world's largest investor engagement initiative on climate change, show some corporate climate progress against key climate indicators, but find much more action is urgently needed from focus companies to support global efforts to limit temperature rise to 1.5° C.

This is the second round of Net Zero Company Benchmark assessments to be released by Climate Action 100+ since March 2021. Measurements were made for 166 companies on the initiative's focus list, on their progress against three engagement goals and a set of key indicators related to business alignment with the goals of the Paris Agreement.

To reflect the pace of change required to limit global warming to 1.5° C and to ensure it is aligned with the most recent science-based policy, Climate Action 100+ updated the Benchmark methodology in 2022, assessing companies against the International Energy Agency (IEA)'s more challenging Net Zero by 2050 scenario for available sectors. It also added new indicators and assessments focused on transition and climate accounting and audit to drive greater company ambition and reflect evolving investor priorities.

The assessments indicate overall year-on-year improvements on cutting greenhouse gas emissions, improving climate governance, and strengthening climate-related financial disclosures. Driven by engagement from Climate Action 100+ investor signatories, the results specifically show that:

- 69% of focus companies have now committed to achieve net zero emissions by 2050 or sooner across all or some of their emissions footprint - a 17% year-on-year increase.
- 90% of focus companies have some level of board oversight of climate change.
- 89% of focus companies have committed to align their public disclosures with Task Force on Climate-related Financial Disclosures (TCFD) recommendations or are listed as a supporter on the TCFD website.

However, the vast majority of companies have not set medium-term emissions reduction targets aligned with 1.5° C or fully aligned their future capital expenditures with the goals of the Paris Agreement, despite the increase in net zero commitments.

Climate Action 100+, which now includes 700 signatories responsible for USD 68 trillion in assets under management, is calling on all focus companies to step up climate ambition before a third round of Benchmark assessments is released later this year.

A*STAR sets up new research institute to support Singapore's sustainability goals

A*STAR has established a new research institute to support Singapore's sustainability goals. Known as the Institute of Sustainability for Chemicals, Energy and Environment (ISCE²), it will advance R&D in areas such as low-carbon technologies, carbon life cycle assessment, sustainable materials and green manufacturing processes, using the latest digitalisation and automation tools.

ISCE² will be partnering academia, public agencies and industry to achieve Singapore's climate change goals, including the Singapore Green Plan and Zero Waste Masterplan; as well as support the local energy, chemicals and pharmaceutical sectors in becoming more sustainable.

Prof Yeoh Lean Weng, Chief Sustainability Officer, A*STAR, will oversee the operations of the new research institute. A key focus of ISCE² is to help industries transition to renewable carbon and green chemistry, and this will be accelerated by digitalisation and automation in three focus areas:

- Decarbonisation, which focuses on reducing carbon dioxide emissions through its conversion to fuels, chemicals, construction materials etc.
- Green materials, including the development of environment-friendly products which are biodegradable and circular materials which can be recycled and upcycled.
- Green processes that reduce the carbon footprint and solvent waste, and improve energy efficiency, for example, in sustainable pharmaceutical manufacturing.

ISCE² is a re-organisation of A*STAR's former Institute of Chemical and Engineering Sciences (ICES), which has key capabilities in organic and biomolecular chemistry, catalysis, formulation technologies and process R&D. These will be combined with core capabilities in sustainable polymer materials from A*STAR's Institute of Materials Research and Engineering (IMRE), and climate change modelling and simulation capabilities from other A*STAR institutes.

The new Institute of Sustainability for Chemicals, Energy and Environment (ISCE²) will advance R&D in areas such as low-carbon technologies, carbon life cycle assessment, sustainable materials and green manufacturing processes.

A*STAR's innovations in sustainability include the use of a single sustainable polymer for the multi-layered packaging of food products. Another example is how A*STAR partners IHI Corporation to transform CO_2 into carbon-neutral methane (natural gas) and olefins. Olefins are often used as raw materials for polymer production.

A further example is how A*STAR, the Singapore Economic Development Board (EDB) and JTC are working with 13 ecosystem partners including Energy & Chemicals (E&C) companies, technology adopters, solution providers and institutes of higher learning, to study and plan for the development of a Carbon Capture and Utilisation Translational Testbed (CCUTT). The CCUTT is to be housed on Jurong Island and aims to accelerate industry adoption of emerging CCU technologies, as part of Jurong Island's transformation into a sustainable energy and chemicals park.

A*STAR, with the support of EDB, Energy Market Authority (EMA), National Climate Change Secretariat (NCCS) and National Research Foundation (NRF), worked on an ops-tech roadmap for Carbon Capture Utilisation and Storage (CCUS) from 2019 to 2020, bringing together academia, industry and public agencies.

"A*STAR has built many deep capabilities in technologies that are important for a sustainable future, and we are now bringing these together purposefully to support Singapore's sustainability goals", said Prof Yeoh Lean Weng, Chief Sustainability Officer, A*STAR.

"A*STAR is working alongside the local R&D ecosystem and industry partners to contribute to meeting Singapore's climate change goals. Leveraging science, technology and engineering, will be key in Singapore's drive towards net zero emissions", said Mr Frederick Chew, Chief Executive Officer, A*STAR.

A*STAR

The Agency for Science, Technology and Research (A*STAR) is Singapore's lead public sector R&D agency. A*STAR's R&D activities span biomedical sciences to physical sciences and engineering, with research entities primarily located in Biopolis and Fusionopolis.

Grants for community leaders in Singapore and Malaysia

Following the launch of the Lendlease Foundation Community Grant Asia in October 2021, Lendlease has awarded grants worth SGD 80,000 to nine outstanding community leaders of social change in Singapore and Malaysia, whose missions are aligned with the foundation's social impact areas. These award recipients were chosen from about 60 applicants that included local charities, community organisations and social enterprises.

The recipients of the grants include three Singapore-based community organisations – Engineering Good, RiverLife and Soapcycling.

In Malaysia, six organisations will receive the grant – Engineers Without Borders, National Cancer Society Malaysia, The Banana Club, IDEAS, Yellow House, and Reef Check Malaysia.

These community organisations support a wide range of causes aligned with Lendlease's Sustainability Framework, such as community inclusion, mental health, upskilling and training, and climate action. They also showcase a genuine community connection.

Lendlease Foundation aspires to create a future where people and communities thrive, while delivering impact across areas that align with Lendlease's Sustainability Framework. Staying true to its focus on value creation and creating positive social change, Lendlease announced an ambitious target of creating AUD 250 million of social value by 2025, through its shared value partnerships, beyond any project or asset obligation.

Siemens to assist companies in the manufacturing sector

Siemens has partnered SkillsFuture Singapore (SSG) as a SkillsFuture Queen Bee to mentor organisations in the manufacturing sector in their digital transformation journey, through project-based, implementation-led training in Advanced Manufacturing and Industry 4.0.

With expertise in industrial transformation and Industry 4.0, Siemens has been providing training to help companies and individuals master skills in Advanced Manufacturing.

At the onset of the COVID-19 pandemic, Siemens rolled out an Additive Manufacturing Learning Programme under the SGUnited Mid-Career Pathways Programme – Company Training (SGUP-CT), to equip mid-career jobseekers with fundamental skills in additive manufacturing and digitalisation, with the aim of moving them into new roles such as automation engineers, advanced manufacturing design engineers and additive manufacturing equipment operators. More than 60 trainees have undergone the programme to-date.

Riding on the success of its SGUP-CT programme, Siemens, as a SkillsFuture Queen Bee, will be rolling out courses in areas such as Industry 4.0 – Technology & Foundation, Additive Manufacturing, Digital Twin, Automation & Advanced Manufacturing, and IoT/Cloud Computing.

Over the three-year appointment, Siemens will mentor local companies in the manufacturing sector on at least 180 Proof-of-Concept projects, to help these companies digitalise their business processes.

The training and mentorship will be conducted at the Siemens Advance Manufacturing Transformation Centre (AMTC), a digital experience centre that provides manufacturing companies with an ecosystem approach to drive adoption of Advanced Manufacturing solutions.

Together with its Original Equipment Manufacturer (OEM) partners like Stratasys, Ultimaker, ExOne, Georg Fischer, EOS and SESTO, Siemens' AMTC emulates a manufacturing environment for companies to test-bed the end-to-end manufacturing process and to pilot projects for honing solutions for designing, manufacturing, implementation and monitoring.

Siemens partners SkillsFuture Singapore as a SkillsFuture Queen Bee to mentor organisations in the manufacturing sector in their digital transformation journey. From left, Ms Isabel Chong, Head of Digital Industries, Siemens ASEAN; Mr Tan Kok Yam, Chief Executive, SkillsFuture Singapore; Ms Gan Siow Huang, Minister of State for Education and Manpower; and Mr Shalabh Bakshi, VP Digital Enterprise Services, Siemens ASEAN.

Companies are supported with consulting services and training by Siemens, its OEM ecosystem partners, and academic and certification partners like CDTI, Singapore Polytechnic and TÜV SÜD.

Minister of State (MOS) for Education and Manpower, Ms Gan Siow Huang, visited the Siemens AMTC on 7 April 2022 and toured the facilities. During the visit, she interacted with staff, AMTC partners and SGUP-CT trainees, and also had first-hand experience with some of the machines used in the manufacturing process.

Meanwhile, Siemens AMTC was recently awarded the Health & Safety Requirements of Additive Manufacturing: PBF-LB/M (powder bed fusion of metals through laser beam) certification by TÜV SÜD, a globally-renowned certification body for quality, safety and sustainability.

Awarded in March 2022, the certification is a testament of Siemens' commitment to the health and safety of its employees and trainees. Siemens AMTC is the first additive manufacturing centre in Southeast Asia to receive this certification, and as part of its mentorship, Siemens will provide companies with a model that they can replicate in their additive manufacturing set-up.

Ms Isabel Chong, Head of Digital Industries for ASEAN, Siemens, said, "We are honoured to be appointed a SkillsFuture Queen Bee. Siemens strongly believes in investing in the future, and this includes the continuous learning and growth of individuals so that they can remain competitive and relevant. We are excited to be part of the ecosystem to help upskill and reskill the Singapore workforce and to play a part in the digital transformation of the manufacturing sector".

Mr Tan Kok Yam, Chief Executive of SkillsFuture Singapore, said, "SSG looks forward to this partnership with Siemens as a SkillsFuture Queen Bee. We believe that this partnership will help us augment the skills of our workforce and raise the manufacturing sector's competitiveness. We are heartened that Siemens has stepped forward to uplift the sector to keep pace with the developments in Industry 4.0".

SATA CommHealth launches electric vehicle for community health screenings

SATA CommHealth has launched the use of an electric vehicle (EV) that will make community health screening for the elderly more accessible and convenient. This is in line with SATA CommHealth's commitment to expand its range of medical services and bring healthcare closer to the community. The EV was officially launched by Mr Ong Ye Kung, Minister for Health, recently, along with SATA CommHealth's Board and Management team.

Since its inception in 1947, providing mobile medical services has always been in SATA's DNA. Today, SATA CommHealth operates a fleet of vehicles providing diagnostic care. The addition of a mobile clinic to the fleet is a timely response to better meet community needs and improve the accessibility of care to patients.

SATA CommHealth CEO, Dr Kelvin Phua, said, "Our overall aim for the launch of the EV is to be a sustainable charitable organisation and support the national agenda to promote sustainability, just like SATA, seven decades ago, when we served the community to fight an epidemic".

Electric vehicles are necessary to meet the rising demand for mobile medical services in a post-pandemic environment. Using EVs will greatly improve the accessibility of care to patients and will benefit patients like the elderly and the needy who might be unaware of their underlying conditions. It will also bring healthcare to the underprivileged to provide them with affordable basic healthcare near home. There are three general directions for the launch of the EV:

- Beyond Hospital to Community – SATA CommHealth partners community partners, grassroots and community facilities (integrated with long-term care partners / corporate organisations) to provide comprehensive healthcare services including Digital Retinal Photography and Diabetic Foot Screening.
- Beyond Healthcare to Health – The EV will be able to bring care upstream to provide preventive care such as health screening, vaccinations, diabetes awareness, frailty assessment for the elderly to prevent falls and osteoporosis and post-pandemic services. The mobile clinic conveniently brings recommended preventive care services to the beneficiaries.
- Beyond Quality to Value – The EV is a one stop basic healthcare facility and the mobile clinic offers government subsidies and SATA CommHealth's Health Endowment Fund to defray 'Out of Pocket' payment for the needy.

The launch of SATA CommHealth's EV is also in line with its Environmental, Social, and Corporate Governance (ESG) approach to roll out an environmentally sustainable operation. Though most of its current fleet operates on diesel, they expect to fully transition to a hybrid fleet of logistics and transport EV and diagnostic buses by the end of 2027 and reduce CO_2 emissions.

During times of endemic diseases, the EV can be deployed to provide services and promote disease prevention and management of chronic disease e.g. Doctors-On-Wheels services. For sustainability, SATA CommHealth intends to work with corporate organisations for community events like health screening and vaccinations. In times of pandemics, the EV can be transformed to a crisis response vehicle and deployed to different sites as a reinforcement or as a remote medical outpost.

SATA CommHealth's electric vehicle will be on the road along with its existing fleet of mobile X-ray buses and dedicated Mobile Medical Services team of competent doctors, nurses, radiographers, clinic assistants and drivers, to bring a wide range of medical services right to one's doorstep.

SATA CommHealth is celebrating its 75th anniversary this year, in August, as a pioneer charitable healthcare organisation and continues to widen its range of medical services to care and serve the nation.

Exterior and interior views of SATA CommHealth's electric vehicle.

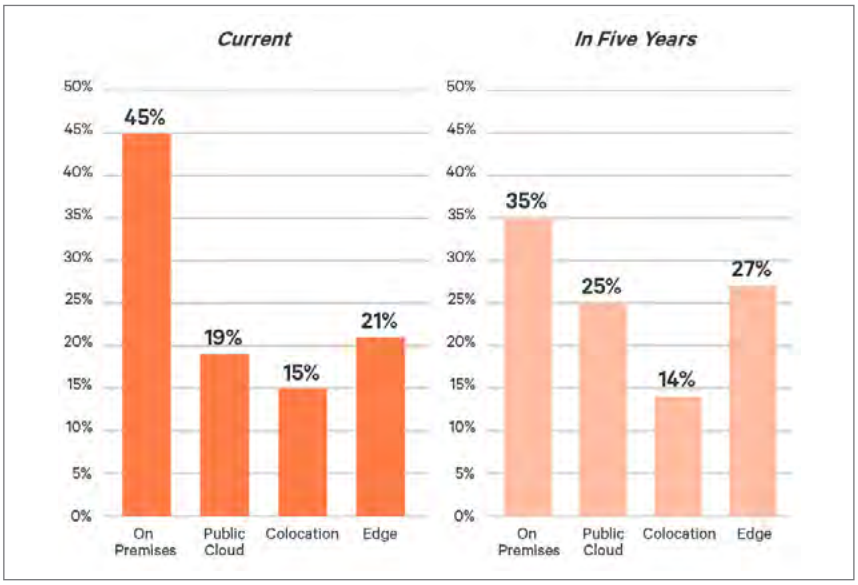
Vertiv highlights results of data centre industry survey

Significant industry-wide investment in edge computing will change the profile of the data centre ecosystem over the next four years, increasing the edge component of total compute by 29% over that time, from 21% of total compute to 27% in 2026. The magnitude of the industry's ongoing shift to the edge is among the notable findings from a new global survey of data centre industry professionals, by Vertiv, a global provider of critical digital infrastructure and continuity solutions.

About a third (34%) of those surveyed are either planning or are in the midst of significant edge deployments. A quarter already have deployed new, purpose-built edge sites, and 41% are operating legacy edge sites. All the activity at the edge is striking, but survey participants also anticipate a 150% increase in core sites and increased activity in the cloud. According to the survey, the percentage of IT resources deployed in the public cloud is expected to grow from 19% currently to 25% by 2026. The demand for computing resources is skyrocketing across today's networks.

"The next five years will reshape the data centre landscape, shifting more and more computing to the edge while buttressing the enterprise facilities at the core of modern hybrid networks. This survey makes clear the urgent demand for computing closer to the end user. The future of computing is about speed and latency, and the only way to meet the need is to build out the edge of the network", said Martin Olsen, Global Vice President for Edge Strategy and Transformation for Vertiv.

"In Asia, a good percentage of those surveyed were either already deploying several edge locations or are planning to deploy a significant number of edge locations in the near future. This tracks with what we are consistently seeing in our business, as more customers shift



Vertiv's survey shows significant investment and growth at the edge of the network.

select deployments to the edge, to reduce latency and improve bandwidth and overall services. But concerns still remain. Survey respondents in the region ranked security and latency at the edge as their top concerns and we are working with our customers to ensure that these are addressed", said Anand Sanghi, President, ASI (Australia/New Zealand, Southeast Asia, India, Japan and South Korea), Vertiv.

The survey results arrive on the heels of the release, late last year, of Edge Archetypes 2.0: Deployment-Ready Edge Infrastructure Models. That report furthered Vertiv's research into the edge of the network and identified four edge infrastructure models that enable a more intelligent, semi-standardised approach to edge infrastructure deployment. The survey results are consistent with the premise of Edge Archetypes 2.0 – that massive growth at the edge necessitates a more standardised approach to edge architecture.

The survey also revealed the changing profile of the modern edge site. Twenty-nine percent of sites feature between five and 20 racks, and 13% have more than 20 racks. More racks mean more power, and the survey results reflect this – 28% say their sites require between 21 kW and 200 kW, and 14% report power demands in excess of 200 kW. The days of single racks tucked away in rudimentary IT closets are over.

Other significant findings from the survey include the following:

- Sustainability is playing a major role in new and planned edge deployments. More than three-quarters of sites (77%) are using or are planning to use energy-efficient UPS systems. In addition, 40% are planning to use renewable energy; 31%, water-efficient cooling; 29%, dynamic grid support technologies; and 19%, refrigerants with a low global warming potential (GWP).
- While security and availability were top priorities of participants deploying edge sites, the survey exposed some current design and operating practices that could reduce the edge computing site's ability to achieve these objectives as the number of sites expands.

Vertiv surveyed 156 industry professionals with insight into their company's edge computing plans.

Regional thought leaders share insights on clean mobility

Future Mobility Asia (FMA) 2022, an integrated global exhibition and conference with extensive display of solutions and concepts, is scheduled to be held from 20 to 22 July 2022, at the Bangkok International Trade and Exhibition Centre (BITEC), in Thailand. An Event Preview was held, with in-person participation, on 30 March 2022, at Bangkok Marriot, Marquis Queen's Park.

Media briefing

Participating in a hybrid media briefing before the Event Preview were Dr Twarath Sutabutr, Chief Inspector General, Thailand Ministry of Energy & Co-chair of Future Mobility Asia Steering Committee; Chanin Khaochan, Deputy Secretary General, Thailand Board of Investment; Trung Nguyen, General Manager – South East Asia, SEA Electric; Josephine Ong, Managing Director, Asia Pacific South, Dassault Systèmes; and Nicole Wu, CEO & Director, EVLOMO.

"Thailand is certainly going towards clean mobility, with plans to implement home charging stations and public charging stations at hotels, department stores and tourist destinations. The government is certainly supportive of clean mobility and we foresee proactive plans and policies to be rolling out in the near future to support the charging infrastructure in Thailand", said Dr Twarath Sutabutr.

Event preview

The FMA 2022 Event Preview featured two panel discussions where senior representatives of the Thai government and industry leaders provided insights into the ASEAN clean mobility ambition and the Thailand 3030 electric vehicle production policy.

Matthew Rowe, Director, Power Grids, Asia – Pacific, DNV opened the first panel discussion by sharing statistics on the energy transition outlook. DNV predicts a 50% increase in passenger vehicles on the road globally by 2050.

"At SEA Electric, we understand that electric mobility is not a cheap investment, hence, we have to work closely with policy makers. Countries across Southeast Asia are rolling out incentives to support businesses in enhancing the future of clean mobility. While we face endless barriers and obstacles from end-users, the government will be of great help to address these concerns. Our participation at Future Mobility Asia, happening in July, is opening up opportunities for us to share experiences with global industry leaders", said Trung Nguyen, General Manager – South East Asia, SEA Electric.

"A thorough understanding of each city is important because the local environment differs by countries and cities. We have to understand the three main topics – environment, economy and the balance between incentives and infrastructure. Taking Singapore as an example, the nation knows that 15% of its land is used for car transportation, hence rolled out a car-lite programme with a goal of moving towards a sustainable environment. Cities will play a critical role to define their economy and implement the best measures, considering the environmental impacts", said Guillaume Gerondeau, Vice President, Senior Director, Transportation & Mobility Industry Asia, Dassault Systemes.

Leading the region with initiatives such as the 3030 EV production policy, Thailand aims to transform 30% of the total automotive production to electric vehicles by 2030.

The second panel discussion was conducted by representatives from the Thai government and Thai experts to discuss the country's plans to become a production hub for clean mobility in Southeast Asia.

"By 2030, Thailand aims to produce 725,000 electric vehicles, with plans to penetrate global markets. We are expecting 400,000 units to be sold in domestic markets while the others will be for exports", said Chanin Khaochan, Deputy Secretary General, Thailand Board of Investment.

The panel discussion further emphasised Thailand's ambition to achieve high production of electric vehicles while maintaining the existing production of internal combustion engine (ICE) vehicles. The panelists shared their concerns and the challenges foreseen, as Thailand adopts clean mobility.

"One of the biggest challenges in adopting electric vehicles is the need for charging infrastructure. Public charging is one of the key factors, to ensure that end-users can travel freely with no constraints, similar to how end-users travel with ICE vehicles", said Yossapong Laoonual, Assistant to President for Sustainability, King Mongkut's University of Technology Thonburi, Honorary Chairman, EVAT.

Future Mobility Asia is organised by dmg events.

HDB to bring solar energy to over 8,000 blocks through the SolarNova programme

Staying on track to meet the target of 540 MWp of solar PV capacity by 2030.

More than 8,400 HDB blocks have been committed for solar installation to-date, to help reduce Singapore's carbon footprint. Image: Sembcorp Industries.

The Housing & Development Board (HDB) has called the seventh solar leasing tender under the SolarNova programme.

The SolarNova programme, led jointly by HDB and the Singapore Economic Development Board (EDB), accelerates the deployment of solar photovoltaic (PV) systems in Singapore and helps drive the growth of Singapore's solar industry. It is also an integral part of the HDB Green Towns Programme (GTP) which aims to make HDB towns more sustainable and liveable. Including this SolarNova tender, HDB has committed a total solar capacity of 380 MWp for about 8,400 HDB blocks, including HDB's efforts prior to the SolarNova programme, when HDB ran pilots on solar initiatives. This is equivalent to powering 95,000 four-room flats with solar energy.

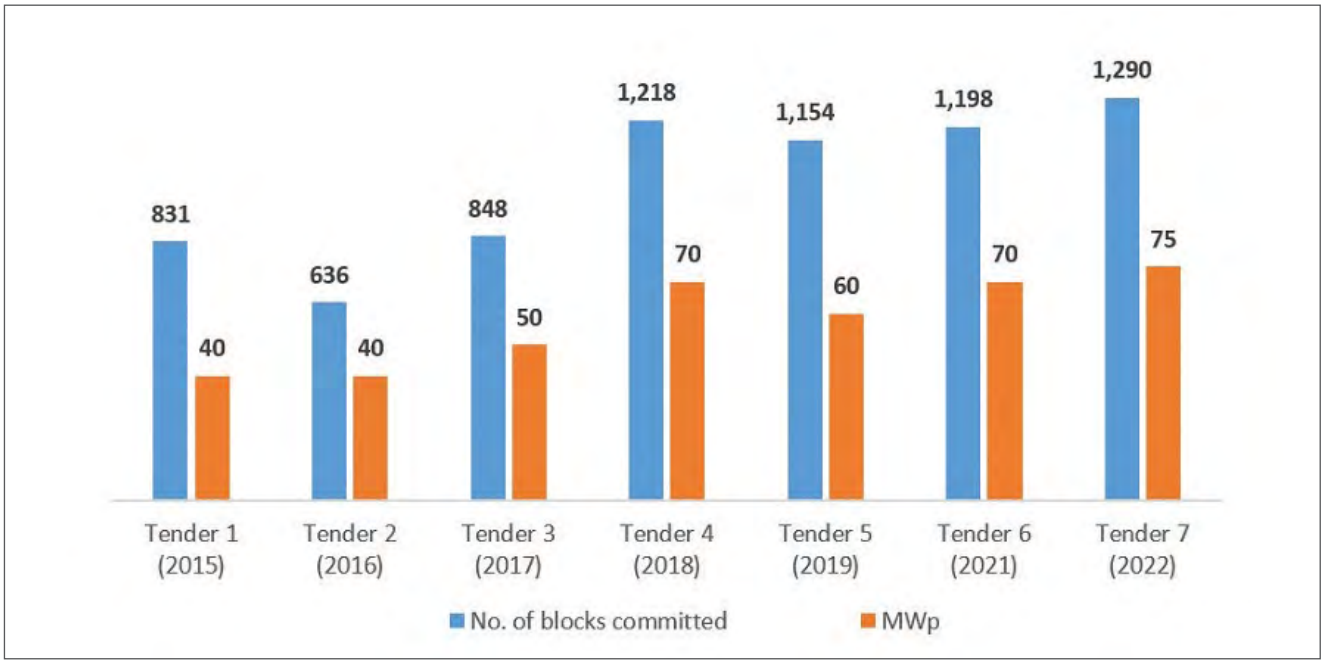
In 2019, HDB announced a new solar target of 540 MWp by 2030, after having achieved its earlier solar target of 220 MWp. This new target could potentially generate 648 GWh of solar energy annually, contributing towards the national solar targets of 1.5 gigawatt-peak (GWp) by 2025 and 2 GWp by 2030, as set out under the Singapore Green Plan.

The latest SolarNova tender, with a solar capacity of 75 megawatt-peak (MWp), aggregates public sector demand for the installation of solar panels across 1,290 HDB blocks and 99 government sites. HDB has progressively rolled out batches of tenders over the years, so as to reap economies of scale and lower costs from the installation of solar panels on neighbouring blocks. These are also subject to tender timelines.

HDB Green Towns Programme

The HDB Green Towns programme, launched in 2020, aims to bring sustainable living to all existing HDB towns by 2030, with large-scale implementation of green features to improve residents' quality of life. One of the programme's three focus areas is to reduce energy consumption from the grid through the harnessing of solar energy.

HDB is the largest driver for the installation of solar photovoltaic (PV) systems in Singapore, today. Under the SolarNova programme, HDB



The SolarNova tenders launched: The figures reflect the details in the tenders called. For Tender 1, the actual solar capacity awarded was 76 MWp.

aggregates public sector demand for the installation of solar panels across HDB blocks and government sites. This generates solar energy and helps to reduce carbon emissions, thereby mitigating the effects of climate change. HDB's 2030 target of 540 MWp could potentially generate 648 GWh of solar energy annually, which is the energy required to power the equivalent of 135,000 four-room HDB flats.

HDB's Chief Executive Officer, Mr Tan Meng Dui said, "Our journey in building up our solar capabilities started 14 years ago on a small scale. Today, there are over 10,000 HDB blocks in Singapore, and we strive to install solar panels on as many HDB blocks as possible. Our solar initiatives are a key part of the HDB Green Towns Programme, enabling us to achieve net-zero energy consumption in our HDB common areas. We will continue to leverage new technologies and smart solutions to support the national goal of achieving a green and sustainable Singapore".

The SolarNova programme

Under the SolarNova programme, solar energy that is harnessed is first used to power common services (eg lifts, lights and water pumps) in HDB estates in the day, with excess energy channelled to the grid. On average, HDB blocks are able to achieve net-zero energy consumption at common areas.

Since the sixth SolarNova tender, vendors have been required to install smart electrical sub-meters at HDB blocks. The meters will enable HDB and the Town Councils to monitor and analyse energy consumption patterns and the performance of common services at each block. With the data, Town Councils can compare energy usage across HDB blocks, and track the demand and supply of energy for individual blocks in the estate.

The data collected will help the Town Councils to optimise maintenance cycles of common services, as well as detect anomalies such as equipment faults. This is in line with HDB's efforts to harness smart technologies to develop Smart Estates, one of the key pillars of the Smart HDB Town Framework. The smart technologies, such as the use of sensors to collect and analyse estate data, will provide information and insights that can help improve estate services by integrating, managing and interpreting data from various sources.

The seventh SolarNova tender involves the participation of six agencies, namely, the Monetary Authority of Singapore, Ministry of Education, People's Association, Singapore Polytechnic, Singapore Examinations and Assessment Board, and Ministry of Health.

The seventh solar leasing tender will close on 20 May 2022 and is targeted to be awarded in 4Q 2022. Installation of the solar PV systems is expected to be completed by 3Q 2025.

Installation of solar panels on HDB blocks

To-date, solar panels have been installed on 2,700 out of the 8,400 HDB blocks included in the programme. Solar panels for the remaining HDB blocks are being installed in batches over the next two to three years. HDB is constantly reviewing its plans to incorporate solar panels on HDB blocks, in tandem with the development of new BTO estates and rejuvenation of mature estates, and will continue to support Singapore's efforts to accelerate its usage of solar energy. To this end, HDB is expected to intensify its efforts to deploy higher efficiency solar panels, install solar panels on more HDB rooftops and catalyse the public sector's adoption of solar energy.

Accelerating transformation towards a more resilient and future-ready built environment

A range of incentive schemes will help to achieve ambitious targets.

Several key initiatives were announced to accelerate the transformation of the Built Environment sector at the Ministry of National Development Committee of Supply debate recently. These include the new Integrated FM/Aggregated FM Grant, an enhanced Green Mark Incentive Scheme for Existing Buildings, and additional funding for the Green Buildings Innovation Cluster Programme and Cities of Tomorrow Programme.

Existing schemes such as the Productivity Innovation Project Incentive Scheme and the iBuildSG Joint Scholarship and Sponsorship Scheme have also been extended.

The Built Environment (BE) sector was hard hit by the COVID-19 pandemic, especially during the Circuit Breaker period in 2020, when firms had to suspend work. However, the sector is seeing signs of recovery. Construction output has now recovered to close to pre-COVID levels, and construction work is progressing at a steady pace. The manpower situation has also steadily improved. Industry partners have been spearheading efforts to implement a tightened end-to-end process to bring in migrant workers in a safe manner.

Some challenges still remain, but the industry has recognised the need to accelerate ongoing transformation efforts to enhance business resilience. The government stands ready with various initiatives to support willing and progressive firms in their transformation journey, and help them enhance their capabilities and capacity for a future-ready BE sector.

Towards a more sustainable and climate-resilient built environment

BCA launched the Singapore Green Building Masterplan (SGBMP) last year, under the Energy Reset pillar of the Singapore Green Plan. The SGBMP has three ambitious targets, or '80-80-80 in 2030', to push for a more sustainable and low-carbon built environment. The new initiatives announced in Parliament will further accelerate the decarbonisation of the built environment, in support of Singapore's net zero aspirations.

To-date, 49% of Singapore's buildings (by Gross Floor Area, or GFA) have been greened. BCA has launched the SGD 63 million Green Mark Incentive Scheme for Existing Buildings (GMIS-EB) 2.0 to help building owners undertake retrofits to raise the sustainability standards of their buildings and contribute towards the first SGBMP target of greening 80% of our buildings by 2030. Under GMIS-EB 2.0, owners of privately owned buildings can receive grants based on the reduction in emissions achieved through retrofitting. Building projects that pursue higher standards of energy performance, such as Green Mark Super Low Energy or Zero Energy, will be eligible for higher funding support. The scheme will be available from 2Q2022.

The second target of the SGBMP is for 80% of new developments to be Super Low Energy (SLE) buildings from 2030. Over the past year, close to 7% of new buildings (by GFA) have been certified as SLE buildings. To encourage more new developments to achieve SLE standards, BCA and URA introduced the Built Environment Transformation GFA Incentive Scheme in September last year. Under the scheme, private sector developments on non-Government Land Sales (GLS) sites can receive bonus GFA if they attain Green Mark Platinum SLE certification, among other requirements. The requirements for GLS sites will also be enhanced for sites launched from 2Q2022.

The third SGBMP target aims for best-in-class buildings to achieve at least 80% improvement in energy efficiency over the 2005 baseline by 2030. As announced under the Joint Segment for the Singapore Green Plan on 8 March 2022, an additional SGD 45 million of funding has been committed from the Research, Innovation and Enterprise (RIE) 2025 Plan for the enhanced Green Buildings Innovation Cluster (GBIC) 2.0 programme. GBIC 2.0 will support the development, test-bedding and deployment of green technologies and solutions for buildings, with a focus on alternative cooling technologies, data-driven smart building solutions and next-generation building ventilation systems.

Taken together, the above efforts will help achieve the SGBMP goals of '80-80-80 in 2030' and transition to a more sustainable and climate-resilient built environment.

Raising the adoption of advanced technologies in facilities management

In addition to transforming the way buildings are built, there is also a need to change the way buildings are maintained through Facilities Management (FM). Not only does optimising building performance at the FM stage help foster better sustainability outcomes, it also reduces maintenance workload for FM teams and enhances their productivity. The adoption of Smart FM technologies to achieve these outcomes also creates good jobs for locals, in areas such as integrated facilities management, digital systems, and data analysis.

For the next phase of FM transformation, BCA will work with industry stakeholders to promote the adoption of advanced technologies including Integrated FM and Aggregated FM (IFM/AFM). This

involves harnessing efficiencies from managing different FM services on an integrated platform, and aggregating FM services across many different buildings. For FM companies and service buyers, IFM/AFM can create up to 20% productivity improvements and cost savings, and even reduce demand for resources such as electricity and water.

As the adoption of IFM/AFM remains nascent, especially for existing buildings, given the high retrofitting costs, BCA will be committing SGD 30 million for a new IFM/AFM Grant. The grant will fund up to 70% of the initial capital investment and retrofitting costs for the adoption of IFM/AFM technologies. To qualify for the grant, FM companies and service buyers will need to transform their procurement models, and build capabilities in their workforce for IFM/AFM. BCA will begin accepting applications for the grant in 3Q2022.

Technology adoption, localisation and innovation

BCA will continue to support BE firms to localise their workforce and become more productive and manpower-lean. The extension of the schemes under the Construction Productivity and Capability Fund (CPCF) announced in Parliament will help firms to make the transition, in light of the workforce moves announced at Budget 2022. First, BCA is extending the Productivity Innovation Project (PIP) Incentive Scheme by another two years, to 31 March 2024. The PIP Incentive Scheme has helped many firms, including SMEs, adopt Design for Manufacturing and Assembly (DfMA) and Integrated Digital Delivery (IDD) technologies that have made construction work more productive. During this two-year extension, firms will continue to receive support of up to 70% of the qualifying costs for the adoption of DfMA and IDD technologies.

The PIP Incentive Scheme has benefited companies such as Unison Construction Pte Ltd, a SME specialising in private residential projects. With support from the PIP, Unison has leveraged a Common Data Environment (CDE) digital platform to share project information such as drawings and BIM models, with various project stakeholders. The adoption of the platform has enhanced collaboration and decision-making for project stakeholders, allowing Unison to achieve productivity savings of more than 30%.

BCA will also extend the iBuildSG Joint Scholarship and Sponsorship Scheme by a year to 31 March 2023. The iBuildSG scholarship and sponsorship programme has seen good success, benefitting more than 3,700 young Singaporeans to-date, by helping them pursue fulfilling careers in the BE sector. The extended programme will only apply to joint scholarships and sponsorships with industry firms. In addition, the co-funding quantum by firms will be increased from 30% to 50%. The intent is to further encourage firms to groom and retain their scholars.

Among the young Singaporeans is Mr Teh Ming Xuan, who first started as an intern at Kimly Construction Pte Ltd (Kimly) and became interested in areas such as DfMA and IDD. He applied for the iBuildSG Undergraduate Scholarship programme in 2020, and was supported by Kimly and BCA for his studies. Today, Mr Teh is working as a planning engineer at Kimly, pursuing his interest in DfMA and IDD and even contributing to Kimly's R&D efforts.

The government will continue to leverage Research and Development (R&D) to push the boundaries for industry transformation through innovation. Hence, a SGD 46 million funding enhancement to the Cities of Tomorrow (CoT) programme will be made available for BE firms and research communities to support R&D efforts and capability building in areas of advanced construction and facilities management.

Increase in clean energy spending by governments

Clean energy spending earmarked by governments in response to the COVID-19 crisis has risen by 50% over the past five months and now stands at over USD 710 billion worldwide, though there are troubling imbalances between regions, according to the latest update of the IEA's Sustainable Recovery Tracker.

This unprecedented amount of enacted spending is more than 40% larger than the global green spending contained in the stimulus packages that governments enacted, following the global financial crisis in 2008. Advanced economies account for the bulk of this effort, with over USD 370 billion intended to be spent prior to the end of 2023 – a level of short-term government spending that would help keep the door open for the IEA's global pathway to net zero emissions by 2050.

Across emerging and developing economies, however, the total amount of fiscal resources being dedicated to sustainable recovery measures is one-tenth of the amount in advanced economies, reflecting their very different financial and economic circumstances. In emerging and developing economies, around USD 52 billion of sustainable recovery spending is planned by the end of 2023, well short of what is needed for a pathway towards net zero emissions by 2050. The gap is unlikely to narrow in the near term, as governments with already limited fiscal means now face the challenge of maintaining food and fuel affordability for their citizens amidst the surge in commodity prices following Russia's invasion of Ukraine.

"Countries where clean energy is at the heart of recovery plans are keeping alive the possibility of reaching net zero emissions by 2050, but challenging financial and economic conditions have undermined public resources in much of the rest of the world", said Dr Fatih Birol, Executive Director, IEA.

Sustainable HVAC Systems - A Key Component to Sustainable Buildings

Greenhouse gas emissions have long been in the spotlight since sustainability became a way of life. According to the 2021 Global Status Report for Buildings and Construction, a significant 37% of CO_2 emissions come from buildings and construction[1]. The same report has also noted that the 2020 global investment in the energy efficiency of buildings has increased by an unprecedented 11%. Stakeholders are recognizing the importance and potential of sustainable buildings.

How do we identify a building as sustainable? A truly sustainable building will have to be less carbon-intensive over their full life cycle. A whole life carbon perspective includes carbon emissions that arise from their construction (embodied emissions) as well as from the use of the buildings (operational emissions).

A prominent segment contributing to operational emissions is the Heating, Ventilation and Air Conditioning (HVAC) systems installed in buildings. Air conditioners and electric fans account for nearly 20% of the total electricity used in buildings around the world according to the International Energy Agency's (IEA) The Future of Cooling report[2]. Driven by the demand for sustainable buildings, the HVAC market has been rapidly evolving to provide more sustainable and more energy-efficient solutions.

Companies like Johnson Controls-Hitachi Air Conditioning are producing HVAC solutions that aim to provide comfort and energy efficiency while keeping operational costs under control. Small-scale businesses like cafes, independent retail stores and other similar establishments can benefit from the Hitachi PRIMAIRY series which is an effective plug and play solution. The outdoor units are designed to withstand a wide range of ambient temperatures and conditions to provide consistent cooling. Under the hood, high efficiency DC fan motors in the indoor and outdoor unit can adjust speed and external static pressure (ESP) automatically during operation (the ESP is set manually during the installation process). This makes the running of the units more reliable, efficient and quiet. As for businesses that require multiple units, the Hitachi Group Control adapter allows 8 PRIMAIRY units to be controlled via one controller conveniently. Flexible piping for the ducted PRIMAIRY indoor units allows installation according to the needs of different sites. The right placement of the indoor unit is key to distributing the air properly.

HITACHI

Apart from that, Johnson Controls-Hitachi Air Conditioning also has VRF systems that bring value to sustainable HVAC solutions. They are highly efficient and versatile for businesses and establishments that require multi-zone climate control. They are ideal for indoor environments where temperatures fluctuate constantly but consistent comfort is crucial like small to medium-sized workplaces or clothing stores. The Hitachi VRF system is a climate control technology that minimizes energy consumption without compromising on performance or comfort. It also helps give business owners complete control over their operational costs. A study by Tsinghua University's (China) Building Technology and Urban Systems Division and Lawrence Berkeley National Laboratory (USA) found that VRF consumed up to 70% less energy for air conditioning than variable air volume (VAV) in Hong Kong office buildings[3]. Not requiring intense structural alterations to the building, VRF systems are also one of the most viable options to upgrade the legacy HVAC systems in old buildings for better energy efficiency. Hitachi SideSmart™ VRF powered by exclusive SmoothDrive™ VRF compressor control technology provides unrivaled efficiency and comfort. It also minimizes energy wastage, with an Energy Efficiency Ratio (EER) of up to 4.51*. Thanks to SmoothDrive™ technology, you can save more energy during partial load conditions, reflecting the real-life usage of VRF systems for better operation and savings on maintenance cost. Its compact size not only reduces transportation and installation costs, but it also frees up space for other beneficial purposes which will make buildings more sustainable like green rooftop gardens. Overall, the SideSmart™ VRF requires 10% less refrigerant than same capacity of Top Flow VRF**, which surely provides a more eco-friendly and superior performance. These are the reasons why Hitachi SideSmart™ VRF was awarded with an energy-efficiency prize in Japan***.

The IoT revolution in the past 10 years has brought the power of connectivity and big data to the forefront. With this, HVAC engineers and operators have been enabled to

design and maintain systems on a deeper, granular level. The simplest example of how IoT has changed HVAC is a user's ability to remotely control an air conditioning unit with a smartphone app. This can optimize the way we use HVAC, helping us conserve energy and make buildings more sustainable. The Hitachi airCloud Pro app is an excellent example of how this technology can be used to reduce a building's energy consumption and carbon emissions. Besides being able to tailor temperatures and comfort levels, this app can also provide a complete analysis of the system's energy consumption, enabling users to take the right actions.

Greener and more energy-efficient HVAC systems can definitely reduce carbon emissions, resulting in more sustainable buildings and cities. Find out more about Johnson Controls-Hitachi Air Conditioning's innovative solutions and products at **www.hitachiaircon.com/sg**.

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-Please note that product features may vary according to model.-

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Footnotes

*RAS-080HNCEL(/R)W
Cooling Capacity: 22.4 kW
Cooling Power Input; 4.97 kW

The cooling performance is the values when combined with our specific indoor units.
Cooling Operation Conditions:
Indoor Air Inlet Temperature: 27.0°C DB (80°F DB) / 19.0°C WB (66°F WB).
Outdoor Air Inlet Temperature: 35.0°C DB (95°F DB).
Piping Length:
8-18HP is 7.5 meter / Piping Lift: 0 meter.

**An internal simulation concluded the following results on refrigerant charge.
Top Flow VRF (RAS-16FSNS): Initial 9.9kg Charge + Additional 19.8kg Charge = Total 29.7kg Charge.
SideSmart™ VRF (RAS-160HNCELW): Initial 9.6kg Charge + Additional 16.3kg Charge = Total 25.9kg Charge

Maximum Piping Length from Piping Connection Kit 1 to Furthest Indoor Unit = 90m
Total Piping Length = 165m
Indoor Units = 2HP Indoor Units x 6 Units
IDU Connection Ratio = 113%

***"Flex Multi-mini Module" (RAS-AP224SSM~RAS-AP1500SSM) [known as SideSmart™ outside Japan] was awarded the Energy Conservation Grand Prize, Product & Business Model Category in FY21, Minister of Economy, Trade and Industry Award.

Upcoming Launch of Railway Asset Management Standards

'The Singapore Engineer' finds out more about three new Technical References (TRs) related to asset management for railway, from Mr Lim Bock Aeng and Mr Ang Hang Guan, Co-Convenors of the Working Groups on the three TRs, under the IES-Standards Development Organisation (IES-SDO).

Mr Lim Bock Aeng

Mr Ang Hang Guan

The three TRs, which will be launched at a webinar on 3 June 2022, are:

- **TR 86 : 2021 Terminology for asset management of rail network assets**
- **TR 95 : 2021 Specification of key performance indicators for asset management in the Singapore railway industry**
- **TR 96 : 2021 Asset condition assessment approach in the Singapore railway industry – Permanent Way**

The Singapore Engineer (TSE): What are the reasons for producing the three TRs?

Mr Lim Bock Aeng (LBA): We hope that the TRs will help to improve planning, interoperability and collaboration in asset management activities, to maximise the value of our railway assets in Singapore.

Mr Ang Hang Guan (AHG): These TRs will provide a common language for rail professionals in Singapore, to discuss, plan and collaborate, through the whole life cycle of the railway assets.

TSE: What are the challenges faced by the railway industry, that led to the creation of the TRs?

LBA: Previously, different stakeholders in our rail transport ecosystem manage assets under their purview, based on their individual established practices and procedures. These TRs are an effort to pull together common knowledge of various key stakeholders, to establish a common language and standardised practices in the railway industry.

AHG: While the various organisations in Singapore's rail sector, from the Authority and Public Transport Operators (PTOs) to the Original Equipment Manufacturers, are competent in asset management, there is a need to develop a common standard across the industry so that all parties can establish a common understanding to facilitate a higher level of collaboration.

TSE: What are the objectives of the TRs?

LBA: TR 86 aims to promote understanding and consistency for railway works related to asset management, by providing precise technical definitions of terms used in regulatory and industry references.

TR 95 describes key performance indicators (KPIs) and the principles of using these KPIs for identified aspects of asset management of railway assets. This TR groups asset management KPIs into key focus areas commonly used in systems engineering and dependability management, in the operations and maintenance phase of the railway system, covering reliability, availability, maintenance and maintainability, safety and sustainability. It also provides guidance on their applicability during various phases

Launch of Singapore's inaugural railway standards

In March last year, the IES-Standards Development Organisation (IES-SDO) launched Singapore's inaugural railway standards, to enhance the overall safety, reliability and productivity of the nation's railway services.

They include TR 81 : 2020 Terminology and abbreviations for the Permanent Way and TR 85 : 2021 Maintenance regime for the Permanent Way.

Since then, there are eight new standards being published, ranging from safety & security, service, maintenance, as well as asset readiness in the rail industry.

To purchase these standards, visit the links below:

Technical References for safety in a rapid transit system
https://bit.ly/RailSafetyRTS

Technical References for the Permanent Way
https://bit.ly/RailPWay

of an asset's life cycle, from the operator's business value perspective, to encourage users to adopt a systems and life cycle approach towards asset performance monitoring and management.

TR 96 describes a common approach towards condition assessment of Permanent Way (P-Way) assets. This will help different entities plan and conduct condition assessments in a consistent way so that the outputs from their assessments can be used to monitor and compare P-Way asset health, and support asset management analysis and decision-making.

What is the scope of each of the TRs?

AHG: TR 86 covers common terms used in asset management-related works in a railway system, such as asset planning, design and build, procurement, operation, maintenance, performance monitoring, modification and renewal as well as decommissioning and replacement.

TR 95 describes the principles and methodologies of defining and measuring asset and asset management performance within the context of the Singapore railway industry. Resource and financial management aspects of asset management and related KPIs are not a focus of this TR and will not be covered in detail. This TR is applicable only to physical assets.

TR 96 applies to the condition assessment of P-Way assets in the Singapore railway context. It describes the way in which condition assessment is performed for P-Way assets, covering the following systems – rail system, third rail system, turnout system, track furniture and track foundation. The overhead catenary system is not included in the list.

Which sectors of the industry are the TRs relevant to and who can benefit from them?

AHG: These TRs are relevant to all sectors of the rail industry. While the current TRs focus on the Operations and Maintenance (O&M) phase in the life cycle of the assets, the new TRs can also provide a useful perspective for those involved in the Design and Build stage. This is important, as the designers can better understand the considerations of the PTOs during the O&M phase.

LBA: Although the TRs were written for the railway asset management context, I believe the terminology, the performance indicators and the asset condition assessment approach can be adapted by organisations and stakeholders in other sectors, who are similarly involved in seeking to maximise the performance of their engineering systems or infrastructure assets against risk and cost pressures, in their respective industries.

Could you provide some details on the forthcoming launch webinar on 3 June 2022?

AHG: The launch webinar will cover the three aforementioned standards and there will be panel discussions that will seek to answer questions that the participants might have. We highly recommend this webinar to anyone who has an interest in the railway industry.

The webinar is complimentary, with the purchase of these three TRs via the QR code provided below. Further information on the webinar will be sent thereafter. Registration closes on 27 May 2022.

Mr Lim Bock Aeng is Director, Asset Engineering (Infrastructure), Land Transport Authority, while Mr Ang Hang Guan is Senior Vice President, Plans and Development, SMRT Trains Ltd.

Webinar on and Launch of Technical References for Railway Asset Management

Friday, 3 June 2022 (2 pm – 4 pm)

This webinar will introduce three new Technical References (TRs) related to asset management for railways. The TRs aim to promote a common understanding and consistency in all the work related to asset management in the railway industry.

- TR 86 : 2021 Terminology for asset management of rail network assets
- TR 95 : 2021 Specification of key performance indicators for asset management in the Singapore railway industry
- TR 96 : 2021 Asset condition assessment approach in the Singapore railway industry – Permanent Way

To purchase the standards, scan the QR code below:

or visit https://bit.ly/RailAssetMngmt

Essential skills technopreneurs and engineering leaders need

by Andy Wee, General Manager, IES Incubator & Accelerator (IES-INCA)

They are ingredients for success.

Whilst journeying with our incubatees who are companies driving breakthroughs in technology commercialisation, we recognise that there are skills that they require, such as 'communicating technology and business value, selling and closing business deals'. These are critical to their success.

While engineers are often very skilled in technical solutions development and implementation, what is also important is the ability to communicate the value and benefits of their solutions to customers, in a clear and tangible manner.

In doing so, engineers can better value sell and justify the appropriate pricing for their work, resulting in better margins and avoiding price wars. In addition, the ability to effectively close the signing of projects successfully with healthy margins is key to business growth and the long-term sustainability of a technology business.

Joining the IES-INCA Incubation/ Acceleration Program

Engineering and technology companies, which are in the scale-up stage of their technology venture journey, can receive support from the IES-INCA Incubation/Acceleration Program, where the founders can tap the knowledge and experience of our mentors and be guided by them, to reduce the learning curve for acquiring knowledge in business as well as technology and market development.

In addition, IES-INCA supports founders of enterprises in business planning and structuring as well as fundraising efforts.

IES-INCA incubatees attending fundraising training with IES-INCA partner, FundedHere, on 10 March 2022.

Two technopreneurs, who have joined the programme, provide more information on their work.

OceanPixel
fluid . energy . intelligence

Dr Michael L Abundo

Dr Michael L Abundo is an electrical and electronics engineer, by training. He is looking into ways to apply his engineering skills into the sustainability space, in particular, the marine renewable energy sector and the wider blue economy.

Question: How did you come to found Ocean Pixel?

Answer: Ocean Pixel, as a company, was spun off from the Energy Research Institute at NTU, due to a combination of factors, one of which was my PhD technical dissertation which focused a lot on suitability analytics for the marine renewable energy industry, using digital tools. The tools serviced project developers for pre-development work which required them to match good sites with good devices, by making sense of the project feasibility, not just from technical and economic perspectives, but by also considering other important criteria.

Q: What are the key products and services of your company?

A: One of the key products we have is our 'data and report products', primarily for the Southeast Asian region, to assess good sites and good devices for technology and project developers. We also have our consulting services where our sustainability and energy engineering specialists provide valuable

Ocean Pixel offers 'data and report products', primarily for the Southeast Asian region, to assess good sites and good devices for technology and project developers.

advice to companies on energy recovery, efficiency and transition. We do pre-development work relating to sustainability initiatives for organisations to achieve transformative action regardless of whether they are land- or sea-based, or small or large projects, thereby value-adding to our clients with our innovative thinking.

Q: Could you share an anecdote about yourself?

A: I have always been a 'water baby'. When I was two years old, I dived into a swimming pool on my own. My parents got a shock but I basically floated and survived. We lived near the sea and everyday, if we could, we would go to the seaside. My fun aspiration is to someday develop, with my colleagues, an offshore renewable energy-powered microbrewery which we will call 'Tidal Beer'. By using resources sustainably, we will create craft beers for everyone's enjoyment!

factorem

Mr Hardik Dobariya

Mr Hardik Dobariya is a mechanical engineer, by training, and the Chief Product Officer at Factorem which is Southeast Asia's first tech-enabled marketplace for custom manufacturing.

Question: Why did you found this company?

Answer: My partner, Alexandra, faced the problem of sourcing parts at the automotive hardware startup she was working for, during an immersion programme in Toronto, Canada. Hardware designers in her team were having a really tough time finding the right supplier to manufacture the unique new designs that they were innovating and prototyping.

As we dug deeper into the supplier side of things, we learnt, via many in-person chats with suppliers, that they have really expensive machines that often lie idle, and there was a big gap between the buyers and sellers in this industry.

In contrast to manually matching buyers and sellers, either via email or by heading down to these machine shops, in-person, to get them to fulfil the client's order, we developed a process that was repeatable. This translated our efforts into a platform which is now developing rapidly to become as automated as it possibly can!

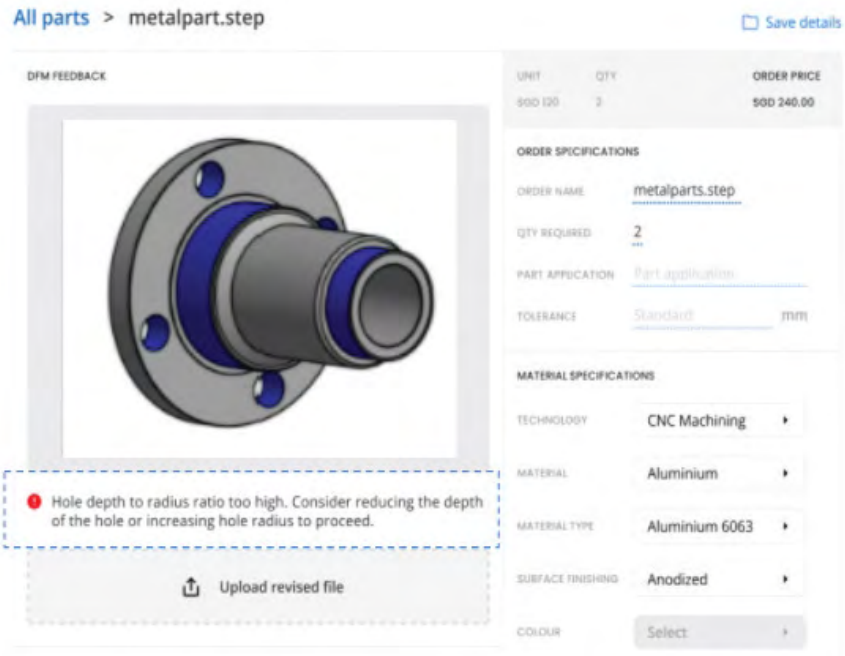
Q: What are the key products of this company?

A: We offer manufacturing services from many verticals, mainly CNC machining, sheet metal fabrication and 3D printing. Our platform offers manufacturers the convenience of uploading the specifications of the parts they need, to get instant quotes and manufacturing feedback, and for suppliers, the platform offers information on jobs in demand, for their machines to work on.

Q: Could you share an anecdote about yourself?

A: One interesting thing I always like to share with people is that I can play the Guzheng, and by far, it is the only instrument that I am proficient at. I accidentally made Guzheng my CCA in primary school but since then have really grown fond of the instrument and the tunes it produces. It has been a great experience being part of a Guzheng Ensemble, alongside my Chinese friends, to perform at concerts and competitions.

More information on IES-INCA be obtained by emailing incubate@ies-inca.com or by visiting https://ies-inca.com/.



Factorem offers manufacturers the convenience of uploading the specifications of the parts they need, to get instant quotes and manufacturing feedback, and for suppliers, the platform offers information on jobs in demand, for their machines to work on.

What are the standards for 5G private networks?

by Jessy Cavazos, 5G industry Solutions Manager, Keysight Technologies

Ms Jessy Cavazos

Industry, as a whole, and the manufacturing sector, in particular, will benefit from their development.

5G's foray into the industrial world starts with the development of standards. 5G private networks also require government involvement for spectrum as well as civilian and military applications, and involvement from industry, for trials, testbeds and ecosystem solutions.

Many industry organisations participate in the development of standards for 5G private networks. The most notable ones are the 3rd Generation Partnership Project (3GPP) and the 5G Alliance for Connected Industries and Automation (5G-ACIA).

3GPP Standards

The first 5G standard release (3GPP Release 15) mainly focused on consumer services. The most recent release (Release 16) and the upcoming ones (Figure 1) offer specific capabilities for the industrial space.

Release 16 introduces significant enhancements to achieve low latency, including the following:

- Uplink pre-emption indication, where the gNodeB (gNB) can tell enhanced mobile broadband (eMBB) user equipment (UE) to stop previously scheduled uplink transmission and clear the channel for higher-priority, low-latency traffic from other UEs.
- Improvements to physical uplink shared channel (PUSCH) repetitions.
- Improvements for uplink grant-free transmission to allow UEs to send data sooner.
- Uplink control information (UCI) changes to introduce the concept of traffic priority.

Release 17 increases the integration of 5G with time-sensitive networks (TSN). This release will also introduce features that improve 5G positioning and reduce latency, which are critical capabilities for factory automation and remote control applications.

Release 18 will be the first release to officially fall under the 3GPP '5G Advanced' umbrella. This release will feature significant enhancements for network intelligence, including the implementation of machine learning (ML) techniques at different levels in the network. Artificial intelligence (AI) enhancements will be essential for more demanding industrial use cases.

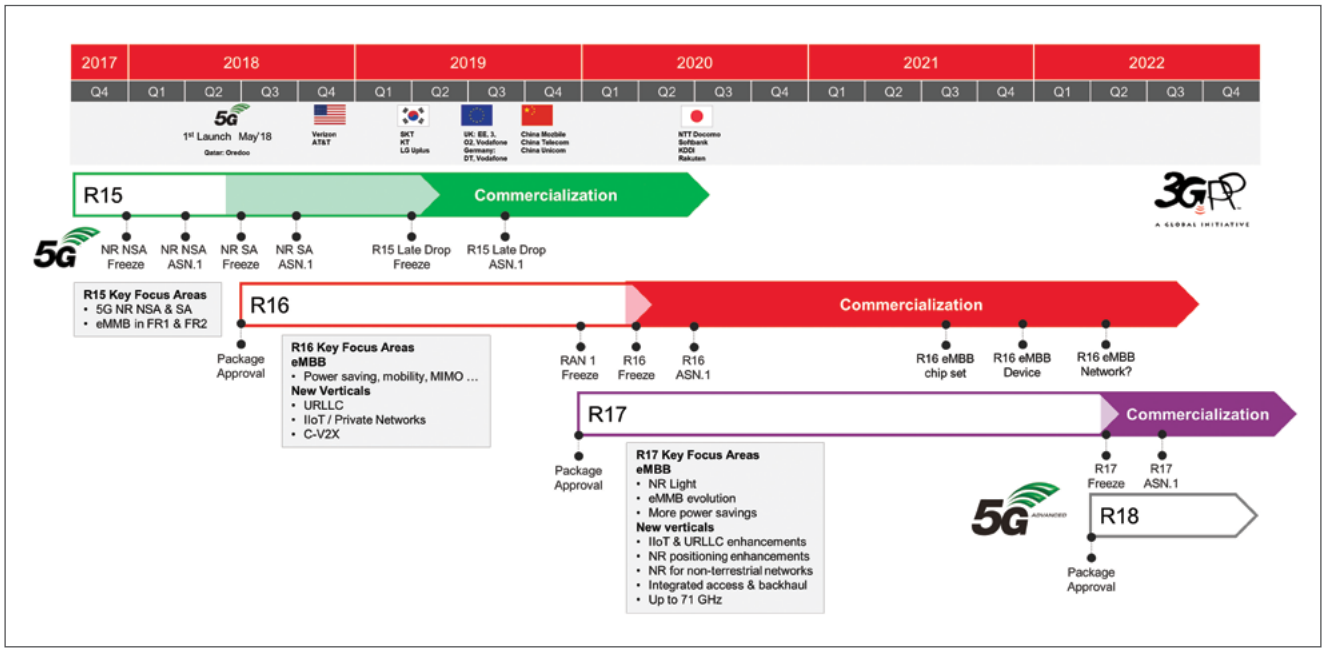


Figure 1: 3GPP Standards timeline.

5G-ACIA's role in defining Industry 4.0 use cases

5G-ACIA played a significant role in developing 5G performance targets by defining use cases in industrial applications.

Although the use of 5G private networks is not specific to any industry, the manufacturing sector has the most to gain in the short term, from adopting these networks.

Tomorrow's smart factories need to implement many applications for their digital transformation. They include big data analytics to make business decisions in real-time and advanced predictive maintenance, monitoring, and tracking of time-sensitive assets in the factory and while in transit.

Other applications include the following:

- Wireless, real-time, closed-loop control and process automation.
- AI-based production control.
- Augmented and virtual reality (AR / VR)-based design and production.
- Wireless and collaborative robots, including automated guided vehicles (AGV) and autonomous mobile robots (AMR).
- Numerous wireless sensors.
- VR-based support and training for remote teams.

These use cases require many wireless connections on the factory floor, ultra-reliable and stable coverage and connectivity, ultra-low latency, and excellent data rates on both the downlink and the uplink.

Applications that require high uplink data speeds and ultra-low latency are rare in the wireless consumer market, but these requirements are paramount in Industry 4.0 applications. 5G wireless networks meet these requirements (Table 1).

Deploying 5G in a factory environment can take different forms. A typical network consists of the following elements:

- UE, including connected sensors, cameras and controllers.
- Base stations with which the UE establishes a wireless link.
- Core network for routing information between mobile clients and edge network elements, billing and authentication services, and tracking the location of mobile clients to maintain links with the devices.

In addition, many 5G private networks leverage multi-access edge computing (MEC) to provide real-time awareness to the 5G system while helping it achieve lower latency by moving computing resources closer to the user.

A 5G private network can be deployed using a dedicated and isolated standalone setup, or a public wireless service provider's infrastructure. Each option offers different levels of security and has specific service and network management needs.

Choosing a deployment model requires careful consideration of the use case, the availability of technical expertise, and the business strategy.

Organisations can decide to own and operate the core network on premises or in the cloud, or they can opt for a third party or mobile network operator to manage the implementation.

Research indicates that two-thirds of manufacturers prefer to fully own and operate their private networks because of security concerns and to keep production data in-house [1].

Use Case	Key Requirements	KPIs to Assure
Motion control	Very low latency, high service availability	QoS: Throughput, latency, bit error rate
Control-to-control communications	Very low latency, integrity, service availability	Dependability: Service availability/reliability
Mobile control panels with functional safety applications	Short bursts of data, periodic and deterministic	RF coverage and quality
Massive wireless sensors and control-to-sensor/actuator communications	Low volume bursts of data, low power utilization, very low latency	Interference and jamming
Mobile robots and AGVs	Low latency, accurate positioning, high data throughput	Interworking with current technologies; TSN integration
Remote access and maintenance	High availability, small bursts of data	Security
Closed-loop process control	Very low latency, high service availability, determinism	Positioning accuracy
Process monitoring	Very low latency, integrity, service availability	Power efficiency
Plant asset management	Positioning, service availability	
Augmented reality	High data throughput, low latency	

Table 1: Industry 4.0 use cases, requirements, and key performance indicators.

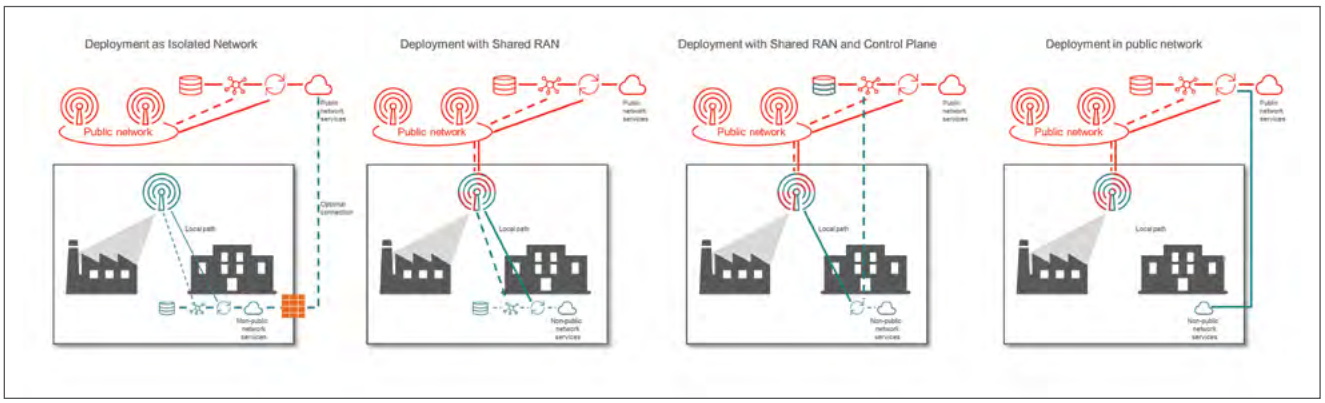


Figure 2: Deployment options for industrial 5G networks (Source: 5G-ACIA).

Figure 2 shows the four deployment options for 5G private networks. The model on the extreme left is the most isolated private network implementation. The radio, control plane and data plane sit inside the factory premises and do not share resources with the public network. This option is the most secure way to implement a private network.

Figure 3: 5G private networks offer many advantages to industries.

Reference

[1] Enterprise Digital Transformation Through Industry 4.0. ABI Research and Nokia, May 2020.

Keysight introduces new 5G test cases

Keysight Technologies Inc, a leading technology company, has announced an extended range of 5G new radio (NR) test cases for device and module validation, according to a carrier acceptance test (CAT) plan defined by China Mobile Communications Corporation (CMCC).

This comprehensive range of test cases is accessible using Keysight's S8707A RF/RRM Carrier Acceptance Toolset (RCAT), part of the company's suite of 5G network emulation solutions. The new test cases address multiple scenarios for validating the radio frequency (RF) and radio resource management (RRM) performance beyond specifications defined by 3GPP, the global standards organisation. China Mobile's carrier acceptance test programme ensures 5G devices used by consumers and enterprises as well as in IoT applications perform as intended on the mobile operator's network.

Keysight offers a comprehensive range of CMCC RF/RRM test cases. Broad test case coverage on common hardware and software platforms facilitates mobile device verification across the RF workflow, from early modem development to device certification and carrier acceptance. Keysight supports CMCC-defined test cases including verifying devices used on high-speed trains and in multiple input multiple output (MIMO) over-the-air (OTA) test scenarios.

Keysight's RCAT enables a global ecosystem consisting of 190 vendors of 5G devices to verify compliance to specifications mandated by standards organisations and major carriers, prior to launching new products. Keysight leverages the company's 5G UXM Wireless Test Platform to enable chipset and device vendors, test houses and mobile operators to efficiently design, develop and validate, as well as gain carrier acceptance for new products, by eliminating siloed data sets and sharing design insights gained across each stage of the wireless device lifecycle.

Keysight's UXM 5G platform supports RF characterisation, protocol compliance and functional key performance analytics for 5G NR non standalone (NSA) and standalone (SA) modes. Users can seamlessly scale to address a diverse set of global spectrum requirements across frequency range 1 (FR1) and FR2 (mmWave) bands, as defined by 3GPP.

The new security demands of our hybrid working future

Mr Gary Gardiner

by Gary Gardiner, Head of Security Engineering, Asia Pacific and Japan, Check Point Software Technologies

Solutions can be developed to meet the complex challenges.

According to the latest figures, more than two-thirds of business leaders are now planning to reconfigure their office space to accommodate hybrid working permanently, and 73% of employees say they want flexible, remote work options to stay as a condition of their employment. Businesses are already making adjustments to their physical and digital infrastructure, but what about security?

Network security in the new normal

The shift to remote networking over the course of the past 24 months has been nothing short of profound. Nonetheless, the rapid move to remote-enabled working has been driven by necessity rather than natural innovation within the market, and that means some businesses are not adequately prepared, in terms of their security setup. Remote user access has become the new normal, offering greater agility and arguably better productivity, but that means legacy security solutions, like static firewalls and basic VPNs (virtual private networks), are no longer fit for purpose. Organisations are now 'hyper distributed', with applications everywhere and networks branching off in all directions. Some may have embraced SD-WAN (software-defined wide area networking) as a means of efficiently routing traffic and increasing the QoE (quality of experience) for users, but even SD-WAN, on its own, has security limitations that need to be separately addressed.

Given the sheer pace of change, it is understandable that businesses would prioritise productivity over network security in the short term, but that short-term fix is now blending into a long-term solution, and businesses need to re-evaluate their security as a result. Traditionally, a patchwork approach to security has led to a disparate array of siloed solutions, from email and browser security, right through to WAAP (web app and API protection), firewall-as-a-service, remote-access VPNs, and more. The challenge now is to consolidate these multiple product points in a unified and cohesive security package, and that is where SASE (Secure Access Service Edge) comes in.

The continued rise of SASE network security

SASE has been reframing how large organisations handle their security, but it is only since the mass shift to hybrid working that it has become relevant for nearly all businesses. What SASE does is converge security and network technologies into a single, cloud-delivered platform that is easy to scale and that facilitates rapid cloud transformation. Geographical borders and physical spaces are becoming less relevant to today's businesses, so it makes no sense for network security to be centralised in the traditional sense. With SASE, security is moved closer to the edge where applications, users and endpoints are located, resulting in an agile, unified, low-latency solution that puts user experience, network performance and network security on an equal footing. The next step is for businesses to connect the security solutions that exist across users and devices, in order to eliminate any security gaps.

Combining SASE with advanced threat prevention

Even when rolling out a SASE solution, businesses need to be mindful of their overall security posture. The more distributed its users, and the more devices that connect remotely, the greater the potential attack surface area for threat actors. Keeping this attack surface limited and protected is arguably one of the biggest challenges.

Check Point's 2022 Workforce Security Report refers to this as the 'remote-access security gap', in which 70% of organisations allow access to corporate applications from personal devices. The report says only 5% of businesses use all of the recommended remote access security settings when preparing to facilitate hybrid working.

What is more, these challenges are emerging at one of the worst possible times for businesses, with cyberattacks against corporate networks increasing. As well as thinking about centralised networks, businesses now have to consider things like endpoint resilience, their vulnerability to mobile-related attacks, remote working security policies, and even how well applications such as Office 365 or G-Suite are protected in real-time.

Check Point Harmony is a unified SASE security solution with a core focus on threat detection and prevention. Not only does it ensure zero-trust access, it is also powered by an advanced real-time threat intelligence platform that can protect devices and internet connections from sophisticated cyber-attacks. Harmony unifies client-less connectivity, endpoint security, email security, internet browsing, mobile security and remote VPN access, under a single, unified umbrella. The result is that sensitive data and users are protected whether at home, in the office or on the move.

Advantages of adopting data-driven technology

Mr Simith Nambiar, Practice Lead – Emerging Tech APJ, Rackspace Technology, explains how industries, particularly those in the manufacturing sector, could reap rewards.

Mr Simith Nambiar

The Singapore Engineer (TSE): The improvements in industrial operations driven by IoT applications are expected to be worth hundreds of billions of dollars annually, in the near future. Could you provide a brief overview of the kind of improvements that can be made?

Mr Simith Nambiar (SN): Organisations in the industrial sector face numerous challenges in driving operational efficiencies. These can be overcome by getting better insights from the data generated by the various machines, predicting machine failure, improving the quality of the products and reducing defects.

The majority of the data produced on the manufacturing floor today is unusable. With more than 200 protocols in operation on the factory floor, gathering data and extracting insights can be difficult. In addition, the manufacturing floor has a mix of legacy and modern equipment or machines.

With the Industrial Internet of Things (IIoT), organisations stand to gain several key advantages that will help improve processes, including efficient and cost-effective resource allocation to enhance machine monitoring, enabling visibility at every stage of the supply chain, and access to key metrics which can lead to actionable insights and intelligence. They can gain insight into their processes and control multiple environments remotely, through IIoT solutions. Specific benefits of IIoT include:

- Enabling the Connected Factory – where telemetry and performance data can be captured from equipment and workstations to view the health of the factory floor, and respond in real-time to equipment failures and production issues.
- Enabling remote monitoring – using a single pane of glass, operational health can be viewed and real-time notifications of anomalous events can be received.

Further, manufacturers need to meet the demand for specialised products in smaller lot sizes. How can manufacturers be more agile and streamline the entire operations to accommodate the changes in business demand?

IIoT enables manufacturers to perform asset tracking, thus improving logistics with real-time tracking of all assets, both within their facilities and across the global supply chain.

TSE: Which industrial sectors are likely to benefit the most?

SN: Companies in the manufacturing and mining sectors, where IIoT is being widely adopted, will benefit the most from such technology, as the downtime within factory plants can lead to millions of dollars lost every year. The ability to gather and share data outside the factory presents immense value to businesses in the manufacturing sector. It provides manufacturers with real-time, actionable insights to help reduce downtime, improve the quality of the entire assembly line, and address the challenges of freeing data from the factory floor. Once the data is ready, manufacturers can start thinking about advanced use cases such as predictive maintenance and automatic detection.

TSE: How can organisations use connected products to build new revenue streams and enhance customer experience through real time, cloud-powered intelligence?

SN: Manufacturers are embarking on a digital transformation journey to increase operational efficiencies on their factory floor, to improve business resilience and prepare for future disruptions. With digital innovations, manufacturing companies can connect their business, supply partners and channel partners, to have end-to-end visibility to stay ahead of customer needs, adapt to market trends and make changes that matter most to customers.

Enterprises need to take this opportunity to build a dynamic IT ecosystem, where enterprises, supply partners and distributors share data transparently and collaborate in real-time. High levels of efficiency and overall visibility allow manufacturers to reduce downtime and immediately respond to changing business needs with minimal manual intervention. By adopting a solution that provides complete visibility into sales contracts, forecasts, customer relationship management (CRM), collaboration, and analysis, manufacturers can efficiently and cost-effectively allocate resources, as well as respond to consumer demands and personalisation.

TSE: How does data from IIoT empower manufacturers to gain insights from their fleet of distributed devices to enhance operations?

SN: Gaining valuable insights from data is driving manufacturing companies to digitalise and adopt IIoT. Organisations are thinking about how they can use the data and insights they have to solve problems. There is growing awareness that the success of digitalisation depends on the ability to access data from machines, in real-time.

According to Boston Consulting Group, it is estimated that by 2030, ASEAN can generate up to USD 600

billion a year in additional manufacturing output, increase annual foreign-direct investment in manufacturing by up to USD 22 billion, and create up to 140,000 new jobs a year, by leveraging technologies and capitalising on the opportunities available to businesses in the region.

The first step towards a smarter factory starts with the collection of data from factory floor equipment and the generation of key metrics that can lead to actionable insights, when measured over time. This stage is the data liberation stage.

For example, a lot of insights and value can be delivered in a very short time through access to real-time dashboards. When employees on the factory floor have access to dashboards or are notified of threshold breaches in the measurements via email or SMS in real-time, they are empowered to take critical decisions.

Once data has been collected, the next phase is to utilise data for advanced use cases like predictive maintenance and anomaly detection using machine learning. Taking a more proactive approach, where the data from the critical assets are processed in real-time, organisations can anticipate machine failure using machine learning techniques.

This helps customers reduce downtime as early indicators of failure can help them conduct maintenance, and replace parts on specific assets showing signs of failure or even before the failure occurs.

Manufacturers can also place an order for spare parts as they identify machine failure patterns to minimise wait times for spare parts. These are just a few examples of how IIoT powers manufacturers in many different ways, and we are seeing a surge in IIoT adoption in the Asia Pacific region.

TSE: How does the adoption of IIoT by local manufacturers help Singapore achieve its Manufacturing 2030 strategy of growing its manufacturing sector by 50% of its current value?

SN: The Singapore Government announced its Manufacturing 2030 Plan in 2021, which aims to expand the sector by 50% of its current value. To achieve the target, Singapore's manufacturing sector needs to innovate quickly and improve the quality of products while managing production and labour costs. The plan also calls for additional investments towards creating better job opportunities locally and upskilling the workforce to effectively transition to new work environments.

With IIoT and cloud technology, local manufacturers can improve processes, increase productivity, eliminate waste and maximise resources. By leveraging IIoT to gather data and use data intelligence to extract insights, manufacturers in Singapore can automate, predict and innovate effectively and efficiently, thereby contributing to national goals.

TSE: A highly skilled workforce is also crucial for smart factories. How can companies attract new talent to the industry and upskill existing personnel?

SN: The Singapore Manufacturing 2030 Plan also emphasises the importance of attracting the best global and local talents to help Singapore continue to be a hub in the global value chain. The government and the manufacturing sector are working with polytechnics and universities to create programmes to upskill and reskill the workforce. By establishing an Advanced Manufacturing Training Academy, the Singapore Government is looking to identify emerging skills for workforce training. In addition, SkillsFuture Singapore (SSG) and the Ministry of Trade and Industry have collaborated to develop industry-relevant training courses in areas such as robotics and Industry 4.0.

To maintain a competitive advantage, companies within the manufacturing sector must prepare for the future of work by ensuring that the workforce possesses the right skills. When implementing a new process, businesses need to ensure that their employees are adequately trained with relevant tools and technologies. In addition, internal training programmes should also aim to develop human-centric skills such as collaboration and communication, along with more technical skills.

Companies can also create a viable pool of future talents through partnerships with universities and colleges. Through these programmes, companies can encourage more students to pursue a career in the manufacturing industry.

TSE: Any other information that you would like to provide?

SN: Strategies for the success of the IIoT project can be seen in action in a case study on the migration to smart factories by medical device maker, Cerapedic. In the first phase of the project, Rackspace Technology built a proof-of-concept IoT solution that connects digital and analogue sensors, extracts data, and sends it to a cloud hyperscaler for analysis and display. The solution then defines the optimal data model; builds a pipeline for data ingestion, enhancement, and storage; and provides scalable, cost-effective, and resilient real time historical analysis. As a result of the partnership with Rackspace Technology, Cerapedic was able to create a working proof-of-concept, within a few weeks, demonstrating the benefits of the smart factory model and meeting stringent compliance requirements.

The manufacturing sector is one of the most important contributors to the region's economy and it is changing rapidly. However, many customers in the Asia Pacific are struggling to bring their data to the cloud and embrace cloud technology. To accelerate digital transformation initiatives, it is important for manufacturers to adopt automation and cloud technology to free customer data from the factory floor. By overcoming this obstacle, manufacturers can then explore the advanced use cases.

(Rackspace Technology is an end-to-end, multicloud technology services company that can design, build, and operate its customers' cloud environments across all major technology platforms, irrespective of technology stack or deployment model. Rackspace Technology partners with customers on their cloud journey, enabling them to modernise applications, build new products and adopt innovative technologies).

Automation improves sustainability

Mr Jonas Berge, Senior Director, Applied Technology at Emerson Automation Solutions, based in Singapore, outlines some of the changes taking place and the approaches that can be adopted, particularly in the chemical & process engineering sector.

Mr Jonas Berge

The Singapore Engineer (TSE): Briefly, what are among the important takeaways from COP-26 and their implications on Emerson's activities in the region?

Mr Jonas Berge (JB): Especially for the chemical & process engineering sector, a vast number of new plants need to be built for decarbonisation and the hydrogen economy. And existing plants must be modified. Process units like the electrolyser, steam methane reformer (SMR), carbon capture unit, pipeline injection skid, refuelling stations and fuel cells – all need a lot of automation. And a lot of this automation is specialised for hydrogen, because hydrogen has some specific challenges such as permeability, embrittlement, ultra-low temperature, ultra-high pressure, high flammability, invisible flame and more.

Emerson can help customers because our products and solutions address these challenges. With the right automation components, you get uninterrupted operation, low maintenance cost, safety, high throughput, high purity hydrogen, hydrogen/natural gas blend within specification, and accurate billing. We are already helping our customers around the world with the energy transition.

TSE: What are the main observations from Emerson Automation's first-ever Emerson Exchange event in Asia Pacific, that was held from 26 to 28 October 2021?

JB: Digital transformation and sustainability & decarbonisation ranked highest among presentation topics. These are two of the four industry megatrends we identified. The other two are autonomous operation and infrastructure modernisation.

Our strategic direction is well aligned with the needs of our customers. We are well positioned for decarbonisation across the hydrogen value chain. With our Plantweb digital ecosystem, we are also well positioned for digital transformation. With our comprehensive digital solutions, plants can improve reliability and reduce maintenance cost, become safer places to work in, reduce off-specification products and cost of operation, as well as improve energy efficiency and reduce emissions. So, there is some synergy between digital transformation and sustainability.

A third megatrend is autonomous operation. The idea is to eliminate the need for people to work full-time or make routine visits to remote locations like offshore platforms or gas fields. This requires automation not only of the production but also of the associated tasks like maintenance inspection.

This enables centralised management of reliability, maintenance, energy efficiency, and emissions etc, from a central location, with visits to sites necessary only on rare occasions. This, of course, ties in with digital transformation, since digitalisation of tasks is key to autonomous operation. This also enables 'work from home' particularly relevant, now, as we continue to face restrictions brought about by the COVID-19 pandemic.

The fourth, and last, megatrend is infrastructure modernisation. This includes control system migration to support new technologies like OPC-UA to make process data available to analytics, HTML5 operator graphics, and support for Ethernet devices. It also includes deployment of wireless sensor infrastructure and replacing mechanical instrumentation like gauges with wireless sensors. A third part of this megatrend is about upgrading field instrumentation, such as putting smart valve positioners on valves, and replacing instrumentation that has mechanical moving parts like tank level gauges and flow meters, with fully electronic devices that have no moving parts.

TSE: Could you elaborate on the metering system provided by Emerson for a large green field oil refinery?

JB: This fiscal metering solution minimises the uncertainty in the measurement of the refinery production and sales. Critical components of this multi-run metering skid project are the large size and capacity of Emerson custody metering systems, including liquid ultrasonic meter, compact prover, flow computer, density meter, control valves, and other sensors. The metering system meets international statutory and regulatory guidelines and showcases Emerson's ability to handle projects requiring international team collaboration.

TSE: Is Emerson involved in the biomedical sector in this region?

JB: BioPharma is an important industry for Emerson, globally. Regionally, you will find Emerson's automation solutions in plants from India to Korea. We are also working closely with institutions such as A*STAR ICES. Our control system, DeltaV Batch for batch manufaturing, is characterised by flexibility, consistency and reduced cycle time. The Syncade MES helps with compliance. New developments include single-use sensors

for single-use bag-type process reactors. Another exciting new development is Module Type Package (MTP) integration support in the DeltaV DCS and Emerson PLCs. This enables modular production methods with flexibility.

TSE: Any other information that you would like to provide?

JB: I would like to add that our Plantweb digital ecosystem, used by customers to accelerate their digital transformation journeys, includes predictive analytics which now offers both rule-based AI, which covers most plant use-cases with readymade apps and without the need for coding or algorithm training, as well as machine learning AI for use in those other use cases. We now have our own modern OT data lake to integrate the various systems around the plant. We have an ever-growing portfolio of wireless sensors to eliminate manual data collection and make analytics more robust and more predictive.

Scaling production and distribution of low-carbon hydrogen

Last year, Emerson had announced a multi-year strategic framework agreement with BayoTech, an innovator in hydrogen solutions, to accelerate the delivery of hydrogen around the world.

Emerson will deliver advanced automation technologies, software and products, to enable BayoTech to build hundreds of hydrogen units to produce cleaner, lower-cost hydrogen.

BayoTech's modular hydrogen generation units produce up to 1,000 kg per day, enough to fill as many as 200 hydrogen fuel cell vehicles. BayoTech's patented technology requires less feedstock, which means lower carbon emissions and less cost to produce hydrogen than traditional reformers.

To meet growing hydrogen demand, BayoTech is leveraging its core technology to develop 5-, 10- and 20-tonne units, which will drive further efficiencies. Using Emerson's programmable logic controller and edge control technologies, remote monitoring and the Microsoft Azure IoT Suite, the unmanned, fully autonomous skids will operate and be monitored remotely from BayoTech's headquarters in New Mexico, USA.

These hydrogen generation units are already being built and will be placed in BayoGaaS hydrogen hubs and at customer sites throughout the US and other global locations. From the hubs, locally produced hydrogen will be distributed to nearby consumers via BayoTech high-pressure gas transport and storage equipment which can transport three times more hydrogen per trip than traditional steel tube trailers. The higher payloads translate into lower transportation costs, higher driver productivity and less carbon emissions.

The strategic framework agreement with BayoTech supports Emerson's commitment to creating innovative technologies and industry expertise in the rapidly developing hydrogen sector. From storing renewable energy to fuelling heavy transport, climate-friendly hydrogen has several energy and non-energy uses. Harnessing hydrogen enables industries to choose clean energy as a cost-effective solution for their business needs.

BayoGaaS hydrogen hubs will produce and supply hydrogen to customers.

Drag finishing polishes targeted surface areas on hip stems

The gains include lower costs, improved quality and consistent finishing results.

To ensure the optimal function of artificial hips in a patient's body, different surface areas on the hip stem must have different finishes. For example, the neck area of the stems requires a very smooth, polished surface.

Recently, a manufacturer of precision components replaced a combined manual grinding / electropolishing operation with a fully automated two-stage mass finishing process. The drag finisher R 4/700 SF from Rösler allows the simultaneous, precise finishing of 12 hip stems in one single operation.

This resulted not only in significant cost savings and lower cycle times but also in dramatically improved quality and consistent finishes.

Since 20 years, MBN Präzisionstechnik GmbH (MBN), located in the Austrian town of Pottendorf, has been specialising in the manufacture of machined precision components and assemblies. The company's main focus is on the production of orthopedic implants and surgical instruments made from titanium and stainless steel.

MBN, certified according to DIN 13485, is not only equipped with modern machinery, including laser marking systems, but has also clean rooms for the coating and germ-free packaging of its products.

Finishing of targeted surface areas on different hip stems

The production is to a large extent automated and allows tracing the entire manufacturing chain, from the raw material to the finished product. Until recently, polishing of the neck area of the hip stems took place by a manual pre- and fine-grinding step, followed by an electropolishing process. This surface refinement operation was time-consuming, required a lot of manpower and was very costly.

In addition, it was less than perfect with regard to consistency of the finishing results and general sustainability. Therefore MBN had been looking for an automated alternative for quite some time. Since only a precisely defined surface area must be polished and a variety of different hip stem shafts must be processed, automating the surface finishing process turned out to be quite challenging.

An application for drag finishing technology

Based on the recommendation of one of MBN's customers, processing trials were conducted by the Rösler sales branch in Austria. The company is not only located nearby but also maintains a combined test and service centre. Rösler experts decided to run the processing trials in a drag finisher. This mass finishing system allows the precise and targeted surface finishing of high-value work pieces with complex shapes. Once the process parameters have been established, the process runs without any variations, thus ensuring repeatable finishing results.

Rösler's comprehensive know-how and experience from the job shop operation helped to quickly develop a two-stage process, with the drag finishing technology. The process, consisting of a wet grinding / pre-polishing step, followed by a dry polishing stage, produces a consistently high quality in short cycle times.

A major feature of the Rösler drag finishing technology is no doubt the vibratory motor mounted below the processing bowl. The vibration of the processing bowl ensures the optimal mixing of the processing media. This results in the absolutely homogeneous finishing of all relevant surface areas on the hip stems.

Fully automatic drag finishing operation with two processing bowls

MBN finally chose a compact drag finisher, model R 4/700 SF. This plug-and-play machine consists of a processing bowl with a diameter of 700 mm and a carousel with four rotating working spindles, each spindle allowing the mounting of three work pieces. The carousel and rotating spindles are equipped with separate drive systems so that the carousel and spindle speeds can be set independently from each other. The drag finishing machine is furnished with a second processing bowl. With a lift truck, the two bowls can be easily and quickly exchanged.

Prior to the grinding operation, the surface areas on the hip stems requiring no finish are masked. Then the implants are manually mounted to special work piece fixtures. For this purpose, a clamping device was developed, that can be used for all stem types and sizes. The work piece fixtures with attached hip stems are then attached to the working spindles.

Once the respective processing program, stored in the programmable system controls, has started, the carousel is lowered so that the rotating spindles are immersed in the processing media. For the wet grinding process, a mix of plastic media with different geometric shapes and a special compound are utilised. Carousel and spindles rotate at the pre-defined speed in opposite rotational directions.

After about half of the cycle time – amounting to less than one hour – the rotational direction is normally reversed. This ensures that the neck area of the hip stems receives an all-around, homogeneous finish.

For the targeted surface finishing of its hip stems, MBN Präzisionstechnik replaced a manual grinding and subsequent electropolishing operation, with a two-stage, fully automatic drag finishing process.

For cleaning of the process water from the wet grinding process, MBN purchased a semi-automatic Rösler centrifugal process water recycling system, model Z 800. Recycling of the process water protects the environment and helps to significantly reduce the finishing costs.

For the polishing operation, a plant-based dry polishing media is utilised. For this process stage, requiring a cycle time of well under 20 minutes, the processing bowl containing the finishing media is simply exchanged with the bowl filled with polishing media.

With the automatic drag finishing process, it was possible to significantly improve the quality and consistency of the finishing results. At the same time, compared to the previous finishing operation, the costs for grinding and polishing of the hip stem neck could be reduced by two thirds.

This investment is expected to be amortised within a three-year period.

All images by MBN Präzisionstechnik GmbH

The hips stems are attached to a specially designed clamping device that can be universally used for all hip stem types and sizes. For the first finishing stage – wet grinding & pre-polishing – a mix of plastic media in combination with a special compound is utilised.

For the second finishing stage, the processing bowl is simply exchanged with another one. The polishing stage takes place in dry mode with a maizorb media, producing a minimum of dust.

Singapore Airshow 2022 highlights sustainability and catalyses recovery of aviation industry

The presence of major exhibitors, partners and trade attendees is evidence of the collective optimism.

Singapore Airshow 2022 was held at the Changi Exhibition Centre from 15 to 18 February 2022. The eighth edition of the event featured the exhibits of almost 600 participating companies from more than 39 countries and regions – representing more than 70% of the top 20 global companies in the aerospace sector.

In line with the global agenda on climate change, Singapore Airshow 2022 partnered with Alton Aviation Consultancy to present the inaugural 'Sustainable Aviation Forum' on 16 and 17 February. Experts from public and private sectors discussed challenges and opportunities within sustainable aviation, including the topic of sustainability of future technology in the areas of air mobility and aviation operations. Focus areas included the roles of regulators; innovations in engine technology; sustainable aviation fuel; and maintenance, repair and overhaul.

The recovery of the aviation industry was another topic that took centre-stage at this year's airshow. Top executives from Avolon, BOC Aviation, CFM International, Malaysia Airlines and Rex Airlines, discussed and debated the pace of market recovery, business resilience and sustainable aviation solutions at the 'Aviation CEO Forum'.

Organised in association with FlightGlobal, this platform presented thought leaders with the opportunity to exchange views on the optimism in Asia Pacific's projected growth and how industry players can link arms to build a better future.

"The aviation industry has proven its resilience by overcoming numerous obstacles over the years. The presence of major exhibitors, partners and trade attendees is evidence of the collective optimism for recovery. We are proud to be rolling out the red carpet for critical conversations, strategic partnerships and new ideas that will catalyse the transformation and rebound of the aerospace and defence sector", said Mr Leck Chet Lam, Managing Director of Experia Events, Organisers of Singapore Airshow 2022.

From left, Deputy Prime Minister and Coordinating Minister for Economic Policies, Mr Heng Swee Keat and Chairman of Experia Events, Mr Ravinder Singh, at the Opening Ceremony of Singapore Airshow 2022, on 14 February. Image: Singapore Airshow 2022.

At the Ribbon-Cutting Ceremony of Singapore Airshow 2022, held on 15 February, are from left to right, Mr S Iswaran, Minister for Transport and Minister-in-charge of Trade Relations; Dr Ng Eng Hen, Minister for Defence; and Mr Ravinder Singh, Chairman of Experia Events. Image: Singapore Airshow 2022.

Aerial displays

Attendees at Singapore Airshow 2022 witnessed flying displays and flypasts by four air forces and two commercial companies. The aerial display was also livestreamed to members of the public who could catch the action from the comfort and safety of their homes.

The exhibition

The list of exhibitors included key industry players like Airbus, Aviation Industry Corporation of China, Bell, Boeing, Eaton Corporation, Israel Aerospace Industries, L3Harris Technologies, Leonardo, Lockheed Martin, Pratt & Whitney, Rafael Advanced Defense, Rolls-Royce, Safran, ST Engineering, Thales, and Turkish Aerospace.

The line-up also included new exhibitors representing a wide spectrum of aerospace and defence products. Among them were Avnon Group from Israel, Diethelm Keller Aviation from Switzerland, Essentium from USA, Shell Aviation from Singapore and Volocopter from Germany.

ST Engineering demonstrates a wide range of capabilities

The group showcased close to 100 of its innovations at Singapore Airshow 2022.

Global technology, defence and engineering group, ST Engineering, brought together multidisciplinary capabilities across its commercial and defence businesses, at the event.

The exhibits featured new solutions on top of proven ones, as well as solutions that have been enhanced or ready to go into commercialisation since their presentation at the last airshow. Such solutions include the latest applications of its unmanned aircraft system, DroNet, in real-life missions at Singapore's reservoirs and Southern Islands; the new hybrid Terrex 8x8 Infantry Fighting Vehicle; and the all-new AGIL Smart City Operating System (OS) which centralises performance data into a single platform to provide analytics-driven insights that power future Smart Cities.

ST ENGINEERING PAVILION

The group's showcase was organised around the Aviation, Defence and Smart City clusters, and featured digital technologies such as artificial intelligence (AI), predictive analytics and cyber solutions that are increasingly shaping the way we work.

Aviation

Highlights at the Aviation cluster included:

- A full-scale aircraft engine nacelle unit featuring innovative design and components made from composite materials to enhance engine fuel efficiency and aerodynamics.
- Passenger-to-Freighter (P2F) conversion solutions, based on Airbus' best-selling fly-by-wire platforms, including the world's first A320P2F conversion that is being done by ST Engineering in Singapore.
- A command and control station for multiple drone operations, with demonstration of ST Engineering's DroNet solution in missions including inspection of aircraft and building assets, surveillance of islands and offshore assets, security, and shore-to-ship delivery.
- Cabin interior solutions featuring an expandable aircraft lavatory prototype designed to meet the needs of passengers with reduced mobility and enhance air travel experience.

Defence

Highlights at the Defence cluster included:

- The Terrex 8x8 Infantry Fighting Vehicle, the 'mothership' that serves as a launch pad for unmanned aerial vehicles and robots, as well as the command centre on the ground.
- The One Connect+ concept which links up various soldier systems, sensors, as well as manned and unmanned systems to provide the command chain with real-time updates. This forms a common situational awareness picture of the battlefield which is critical for any command centre, be it for military, public safety, emergency response, crisis management or specific missions.
- Training and simulation software applications which use the latest Virtual Reality/Mixed Reality technologies for realistic multi-user experiences across multiple domains.
- ExtremV, which is strategically positioned between the defence and public security sections. It is an example of how ST Engineering can adapt its flagship defence platforms for the public security and commercial sectors. Retaining the superior mobility of the Bronco All Terrain Tracked Carrier, the vehicle's cabins have been redesigned and can be configured for firefighting and Humanitarian Assistance and Disaster Relief (HADR) operations.
- The marine showcase for maritime security, HADR and homeland security solutions.

Smart City

Highlights at the Smart City cluster included:

- The new AGIL Smart City OS which was exhibited for the first time. As the digital backbone of future Smart Cities, the AGIL Smart City OS integrates disparate IT and OT systems and centralises performance data into a single platform to provide analytics-driven insights that optimise resources and improve operational efficiencies and sustainability outcomes.
- Smart Security solutions including the Next-Generation Fast Response Car and autonomous security robots that support authorities on ground response operations, as well as the new AGIL Secure Biometric E-Gate which was unveiled at the airshow. The E-Gate offers enhanced features including multi-traveller identity verification and multimodal biometric authentication that accelerate border control processes, while providing safer, contactless and seamless traveller experiences.
- A first-of-its-kind in Asia and exhibited at the airshow for the first time, the TunnelFox is an autonomous, intelligent rail asset inspection innovation that improves the efficiency and accuracy of anomaly detection in critical rail assets.

SIA finalises order for A350F freighter aircraft from Airbus

The aircraft will increase operational efficiency while, at the same time, reducing fuel consumption.

The new order will enhance SIA's capabilities in the air cargo market. Image: Airbus.

Singapore Airlines (SIA) has finalised a purchase agreement with Airbus for seven A350F freighter aircraft. The order was signed at Singapore Airshow 2022, by SIA CEO, Mr Goh Choong Phong, and Airbus Chief Commercial Officer and Head of Airbus International, Mr Christian Scherer.

The order firms up the carrier's commitment to the new generation freighter announced by the plane maker in December 2021.

"This order underscores the importance of the cargo market to the SIA Group. The introduction of the A350F will enhance our capabilities in this key sector, ensuring that we are ready for the growth opportunities that will arise in the coming years. These new-generation aircraft will substantially increase our operating efficiencies and reduce our fuel burn, making an important contribution towards the success of our long-term decarbonisation goals", said Mr Goh.

"Singapore Airlines is the world's largest operator of the A350 and is now set to become the first to fly the all-new freighter variant. The A350F will fit seamlessly into the carrier's existing fleet, while redefining the operational efficiency of its cargo operations. It will bring a 40% reduction in fuel consumption and emissions compared with the aircraft it will replace at SIA, while offering the same payload-carrying capacity and longer range. Consumer patterns have changed dramatically in recent times, generating increased demand for the swift transport of cargo by air. With the A350F, SIA will be well-positioned to respond to this enormous market potential in a profitable and sustainable way", said Mr Scherer.

The A350F meets the imminent wave of large freighter replacements and the evolving environmental requirements, shaping the future of air freight. The A350F will be powered by the latest technology, fuel-efficient, Rolls-Royce Trent XWB-97 engines.

The A350F is based on one of the most modern, long-range, passenger aircraft families. With a 109-tonne payload capability, the A350F will serve all cargo markets. The aircraft features a large main deck cargo door, with its fuselage length and capacity optimised around the industry's standard pallets and containers.

More than 70% of the airframe will be made of advanced materials, resulting in a 30 tonne lighter take-off weight, and generating at least 20% lower fuel consumption and emissions over its current closest competitor. The A350F will fully meet ICAO's enhanced CO_2 emissions standards coming into effect in 2027.

Singapore Airlines is the world's largest operator of the A350, with 58 currently in service.

Airbus Asia Training Centre inaugurates fourth full flight A350 simulator

The Airbus Asia Training Centre (AATC) has inaugurated its fourth A350 Full Flight Simulator (FFS).

The addition consolidates AATC's position as the largest Airbus-operated flight crew training centre in the company's global network, with two A320, two A330, one A380 and four A350 simulators. AATC also hosts one ATR 72-600 FFS.

The focus on the A330, A350 and A380 reflects the popularity of Airbus wide-body aircraft in the Asia-Pacific region.

AATC is a joint venture owned 55% by Airbus and 45% by Singapore Airlines (SIA). At almost 10,000 m² in size, the facility at Seletar Aerospace Park is part of the Airbus Flight Training Network and serves the Asia-Pacific region and beyond. Since operations began in April 2016, AATC has successfully attracted 69 airline customers. AATC has the capacity to offer type rating and recurrent training courses for up to 10,000 trainees per year.

Pratt & Whitney's MRO footprint in Asia Pacific continues to grow and modernise

The company is preparing for the anticipated recovery of the aviation sector.

Pratt & Whitney has had a presence in the Asia-Pacific region for nearly 40 years, while serving customers in the region even longer. The region is the fastest growing in the aviation industry, with a forecasted demand of almost 8,000 new aircraft required over the next decade.

Pratt & Whitney is investing now, and keeping an eye to the future, to ensure it delivers for its customers.

"Within Asia Pacific, Pratt & Whitney is part of a thriving ecosystem of airlines, MRO providers and manufacturing, that is expanding to support demand. Pratt & Whitney has a strong presence in the region with overhaul centres, customer training centres, field offices and a diverse customer base, flying more than 1,700 Pratt & Whitney-powered aircraft. Knowing two-thirds of the forecasted aircraft needed in the region are anticipated to be narrow-bodies, Pratt & Whitney is also strategically expanding its GTF MRO network, with eight shops announced, of which three are currently active", said Mary Ellen Jones, Vice President of Asia-Pacific Customer Business at Pratt & Whitney.

Pratt & Whitney is also strengthening the teams it has in the region to meet increased incremental shop visits. By the end of 2022, IATA forecasts global Revenue Passenger Miles (RPMs) will recover to about 65% of 2019 levels with domestic travel recovering to be approximately in-line with 2019 levels and international travel recovering to about 50% of 2019 levels. To meet this demand, Pratt & Whitney's Aftermarket Operations is hiring nearly 900 employees this year, with over one-third of those new hires within Asia Pacific.

"We are focusing now on automation and sustainability advancements. Pratt & Whitney is committed to inserting technology across our facilities while simultaneously re-imagining operations and pursuing greener practices. The technology adoption is a multi-year plan to further enhance operational efficiency and productivity and to develop into an Industry 4.0 ready organisation. Across the board, we have begun to reskill and upskill employees to ensure that they are ready for tomorrow's technologies, today", said Tim Cormier, Vice President of Asia-Pacific Aftermarket Operations at Pratt & Whitney.

Pratt & Whitney is collaborating with Singapore to establish a technology accelerator programme that will increase the speed and scalability of technology insertion across its Aftermarket sites in Asia Pacific, and ultimately across its global Aftermarket organisation.

To-date, Pratt & Whitney has seen enhanced operational effectiveness from technology insertion initiatives within the region:

- Component Aerospace Singapore successfully deployed the first-in-MRO application of 3D printing for aero-engine component details, while pioneering robotics in the MRO sector, including the development of an automated system to replace manual fixtures for tube repair.
- Engineers at Eagle Services Asia have developed a robot that is assisting technicians on shop floors. They now have time to focus on more substantive work.
- Pratt & Whitney Component Solutions implemented an industrial simulation pilot. The industrial simulation software package creates a Digital Twin of a factory, showing movement of product, people, process steps and inventory, and allowing for analysis of cycle times, turnaround times, cost, quality signature, and overall equipment effectiveness, at the press of a button. The pilot resulted in optimised floor space and increased productivity.

"The aviation industry is incredibly resilient. We collaborated closely with customers to tailor maintenance plans to the reality of the pandemic. We took advantage of the downturn in traffic to incorporate planned upgrades to fleets. And now, we are powering the segments that are recovering most quickly. V2500 and GTF engines are powering narrow-bodies and the PW4000 engine, which primarily powers freighters, has seen continued strength throughout the pandemic. We are ready to support our global customers throughout the continuing industry recovery and beyond", said Joe Sylvestro, Vice President of Aftermarket Global Operations at Pratt & Whitney.

About Pratt & Whitney

Pratt & Whitney is a world leader in the design, manufacture and service of aircraft and helicopter engines, and auxiliary power units.

Pratt & Whitney is strengthening its Aftermarket Operations and is a pioneer in the application of robotics in the MRO sector.

Optimised tools for tomorrow's sustainable aircraft

by Steve Weston, Industry and Tech Centre Manager – Aerospace, Sandvik Coromant

They are necessary when working with difficult-to-machine materials.

Tomorrow's sustainable aircraft will rely increasingly on next generation powder-based, heat resistant super alloys (HRSAs) and advanced ceramic matrix composites (CMCs), as they can withstand high temperatures for more efficient fuel burn and low emissions. However, these materials are required to be heat resistant, creep resistant and keep good material properties under extreme temperatures. This presents challenges at the machining stage.

The UK Innovation Strategy report says that new technologies and processes will be key to manufacturing and machining these advanced materials at scale. Collaboration within the industry will also be essential, which is already being demonstrated at the Advanced Manufacturing Research Centre (AMRC) in Sheffield, UK.

Sandvik Coromant was one of the original members to join the AMRC when it was founded in 2000, along with Boeing and Messier Dowty (today Safran Landing Systems). They were later joined by the likes of British Aerospace, Rolls-Royce, GKN Aerospace and Airbus, and today, the AMRC has approximately 118 members in total. Most of the centre's projects are collaborative by nature, funded and selected by all members, and the AMRC now employs over 500 highly qualified researchers and engineers from around the globe. All are devoted to multi-million pound projects that can support a strong, pro-innovation economy.

In the aerospace sector, if we are talking about sustainability, then new technologies and processes should focus on the ability to combust new fuel types, like sustainable aircraft fuel and liquid hydrogen, to create lower emissions. As always, the ability to run hotter means there is a more efficient fuel burn. If we couple this with higher compression ratios, which most new and future engines can support, then the result is greater efficiency. That means less fuel is combusted with increased power and reduced noise.

Innovations for sustainability

With aero engines, the core of the engine is relatively small and the fan on the front is relatively large. So, a limiting factor is how fast you can rotate the fan. To remedy this, over the last five to 10 years, gearboxes have been introduced between the fan and the core of the engine. They enable the fan to run more slowly while the engine core runs faster for high compression and better fuel efficiency.

However, HRSA components are needed to make this work. Such materials are metallurgically-composed to retain their properties when exposed to extreme temperatures. But this also means the stresses generated when machining these materials are high. The unique capability of these nickel-, iron- and cobalt-based super alloys to perform close to their melting point also gives them generally-poor machinability.

One part that is increasingly used in aerospace is the blisk, a component that comprises both a rotor disk and blades. Unlike traditional disks, which have slots in the outside diameter that blades fit into, blisks combine the disk and blades into a single component and are lighter than conventional disks with blades. This decreases the number of components in the compressor while, at the same time, decreasing drag and increasing the efficiency of air compression in the engine by around 8%.

Blisks are generally located on the cold compressor side of aircraft engines and are usually made of titanium in the first instance, then migrating to HRSA materials when they are closer to the combustion chamber. Machining these components effectively, and to the highest standards, requires optimised tools and process knowledge relevant to these advanced materials.

Sandvik Coromant's internal project areas focus strongly on a variety of key aero engine components and features. They include disks, blisks, shafts and casings, among others. In particular, we are seeing increased use of blisks in today's gas turbine engines and expect this trend to continue, as the last ounces of potential power and fuel efficiency are extracted from current engine architectures.

However, blisks present unique machining challenges because they are often made from HRSAs. The components demand tight dimensional and geometrical tolerances, while maintaining high standards of surface integrity and surface finish.

More secure machining

In response to these machining challenges, Sandvik Coromant offers a number of tooling solutions to support cost-effective, high-quality machining of aero engine components. One such method, that Sandvik Coromant recommends, is high feed side milling. The technique involves a small radial

New technologies and processes are especially prevalent in manufacturing mid-sized, single aisle planes like the Airbus A321.

Blisks, comprising both a rotor disk and blades, are increasingly used in aerospace but present unique machining challenges.

engagement with the workpiece, which allows increased cutting speeds and feed rates and axial cutting depths with decreased heat, chip thickness and radial forces.

To support this method, Sandvik Coromant has developed the CoroMill Plura HFS high feed side milling range. The range features a series of end mills with unique geometries and grades, and is made up of two end mill families. One family is optimised for titanium alloys, the other for nickel alloys. Chip evacuation and heat are specific challenges when machining titanium, so the first family presents a solid version of the tool for normal chip evacuation conditions. The second family features internal coolant and a new cooling booster for optimum swarf and temperature control.

A customer trial was performed to test a 12 mm diameter CoroMill Plura HFS end mill against a same-sized competing tool. This trial involved machining a low-pressure turbine (LPT) case made from aged Waspaloy 420 nickel-based alloy, using a horizontal machining centre with an increased axial depth-of-cut and reduced radial depth-of-cut. The outcome was that metal removal rates were increased substantially with CoroMill Plura, leading to an impressive 198% productivity increase for the customer. The solution has also been applied to blisks as well as turbine disks and casings, machining blades and weight reduction scallops.

Other solutions in Sandvik Coromant's portfolio include its next generation turning grades, in both carbide and polycrystalline cubic boron nitride (PCBN), which are designed for the high-speed finish turning of components made from ISO S materials. The grades are, in turn, complemented by next-generation ceramic rough turning grades designed for class-leading performance. The latest finishing grades are being tested and optimised by Sandvik Coromant to deliver consistent surface integrity that is demanded by aerospace engine manufacturers, while also producing components consistently to tight tolerances.

The future

As outlined in the UK Innovation Strategy report, global hubs for innovation, like the AMRC, will continue to see 'companies of all sizes creating breakthrough new products, becoming more efficient and scaling to full growth, all with an eye to the global, as well as domestic, market'.

HRSA components, such as blisks, will also become more prevalent in tomorrow's sustainable aircraft. Certainly, one of the leading aerospace manufacturers that Sandvik Coromant works with at the AMRC is developing larger ultra-fan engines, to achieve super fuel-efficient designs that run on biofuels. Other key innovations include flexible resin-transfer moulded blades that are designed to untwist as the fan's rotational speed increases. These technologies are already prevalent in mid-sized, single aisled planes such as the Airbus A321.

Other future predictions indicate that mid-sized aircraft will be the first to run on hydrogen, while smaller domestic planes will drive electric ambitions. There are now many small start-up companies that produce smaller electric engines for aircraft, and CNBC reports that the market for flying cars – known as electric air taxis – could rise to USD 1.5 trillion globally by 2040. There might even be regionalised landing points in the future. For instance, passengers may board a hydrogen plane to travel more locally, say around Europe, or a biofuel plane to fly further afield to a location like the US.

At the component level, these applications will rely on next-generation materials for which Sandvik Coromant's optimised tooling solutions, and its extensive process and application knowledge, would be relevant. Sandvik Coromant and the AMRC will help to ensure that optimised process design remains critical for aerospace's leading manufacturers, and also for people and the planet.

Collaboration on advanced air mobility operations

The focus will be on operations, vertiports and surrounding infrastructure.

Rendering of a vertiport.

Rolls-Royce and the Luxaviation Group, a leading luxury jet and helicopter service provider, have announced plans to collaborate on leading the development and deployment of Advanced Air Mobility (AAM).

Rolls-Royce will provide electrification solutions, maintenance support services, and digital solutions for Luxaviation Group's planned network of vertiports. Luxaviation already has a presence at over 120 VIP terminals across the world. Both companies share a vision of Advanced Air Mobility solutions including all-electric and hybrid-electric vertical take-off and landing as well as fixed-wing commuter aircraft.

The Memorandum of Understanding between Rolls-Royce Electrical, Rolls-Royce Power Systems and Luxaviation focuses on operations, vertiports and surrounding infrastructure to support these new markets that will transform the way we travel. The strategic partnership will look at three main areas:

- Charging and energy infrastructure for vertiports.
- Maintenance provision for electric aircraft.
- Digital solutions for related applications across AAM.

Rob Watson, President of Rolls Royce Electrical said, "Rolls-Royce will be the leading provider of all-electric and hybrid-electric power and propulsion systems for Advanced Air Mobility. As part of our strategy, we are looking to ensure we understand how we can deliver maintenance and services for these new aircraft, building on our existing MRO and analytics capabilities. We are delighted to collaborate with Luxaviation who we believe will be a leading player in the AAM industry and believe that this collaboration will help both partners to be at the forefront of this new market".

"This strategic partnership also leverages capabilities and technology across Rolls-Royce as we develop the electrical power and propulsion systems for eVTOL and commuter aircraft. Rolls-Royce is set to build on our existing network to offer maintenance services for electrical systems. Further, Rolls-Royce Power Systems is able to offer microgrid solutions to support fast-charging of electric aircraft and deliver reliable, cost-effective and climate-friendly, sustainable power to vertiports", he added.

Christophe Lapierre, Luxaviation's Head of Strategy and President Business Aviation Support Services said, "We are convinced that Rolls-Royce and Luxaviation, two market leaders with a global network, talent, expertise, and vision across the entire value chain will accelerate the deployment of Advanced Air Mobility through this strategic partnership".

"Our common vision to enable early adoption by leveraging existing capabilities places this partnership at an advanced position, considerably pushing the evolution of this new industry segment. Our concept is to provide a solution that is agile and in continuous evolution to scale up Advanced Air Mobility operations alongside regulatory development pace and market demand", he added.

With over 60 years of experience in operations, Fixed Based Operator (FBO) passenger services and hundreds of aircraft under management, Luxaviation Group has launched various projects promoting the future of Advanced Air Mobility. The first deliverable of this partnership will be the creation and implementation of a pilot project outlining electrical solutions.

Last year, Rolls-Royce announced a pathway to net zero carbon emissions and its electrical technology is one way in which the company is helping decarbonise critical parts of the global economy. Rolls-Royce is committed to ensuring its new products will be compatible with net zero operation by 2030 and all its products will be compatible with net zero by 2050.

YOUNG ENGINEERS CAREER SERIES WEBINAR MARKS FIRST SUCCESSFUL COLLABORATION WITH IMechE

On 28 March 2022, the eighth Young Engineers Career Series webinar took place over Zoom. Titled "Realising the Full Potential of Your Engineering Knowledge & Creating Supply Chains for the Future", the webinar was jointly organised by the IES Young Engineers Committee and the Institution of Mechanical Engineers (IMechE) Singapore Branch.

The webinar attracted more than 250 registrants from 10 countries, which included both practising engineers and students.

Chairman of the IMechE Singapore Branch, Mr B.K. Oberoi (Kogi), began the webinar with his talk on realising the full potential of one's engineering knowledge and engineering for a better world.

The key point he made was the importance of knowing and applying the fundamental knowledge of engineering to solve day-to-day problems.

For example, he noticed that the tyres used in rental bicycles were of poor quality materially. When these tyres hit road kerbs during accidents, they would then cause the bicycle to break up, thus posing a danger to the riders. Using his engineering knowledge, Mr Kogi demonstrated to the participants his hand-made solutions which provided greater rider safety.

The second speaker was Mr John Smith, Chief Supply Chain Officer, Suntory Beverage and Food. He spoke about creating supply chains for the future, in view of current global challenges such as the growing population, diminishing natural resources, urbanisation, greenhouse gas emissions, changing consumer demand and pandemics.

As such, engineers were critical to progress, and he urged participants to take the lead in creating a better future through R&D, leveraging new technology (especially biotechnology), think out of the box on sustainable supply chain design, and participate in the consumer education process to encourage them to make fact-based choices.

During the Q&A session, a question was raised about how to discover one's passion at work. Mr Kogi and Mr Smith felt that the application of engineering knowledge to make a difference was key. Likening the engineer experience to being a sportsman with rigorous training, Mr Kogi noted that doing one's best was more important than being the best.

On the other hand, Mr Smith exhorted participants to be daring in trying different things at the workplace, so as to figure out one's passion and then make a career out of it. Comparing life to a marathon, rather than a sprint, he encouraged the young engineers present to consistently gain experience through it, and to remain resilient always.

He ended the webinar on a high note with a thought-provoking quote from Winston Churchill: "Success is not final; failure is not fatal: it is the courage to continue that counts."

IES SIGNS MOUS WITH LOCAL AND OVERSEAS PARTNERS

In the month of April, IES signed two Memorandums of Understanding (MOUs) to further our collaborations with local and overseas partners.

On 1 April, an MOU was signed with the Korean Professional Engineer Association (KPEA). The five-year renewable agreement aims to deepen collaboration in four areas: Internship exchange, conference organisation, development of industry projects, and mutual support in engineering MICE events.

The six-person visiting delegation was led by KPEA President Dr Joo Seung-ho, alongside KPEA advisors and senior executives, as well as members of the Accreditation Board for Engineering Education of Korea (ABEEK).

They were hosted by IES Deputy President Dalson Chung, Emeritus President Er. Tan Seng Chuan, and the IES International Outreach Committee.

Separately, IES Academy signed an MOU with Singapore Water Association (SWA) on 18 April. The ceremony took place during the Singapore Business Forum, which was organised as a part of Singapore International Water Week 2022.

Through this collaboration, IESA will leverage on SWA's expertise in e-learning platform development to build a solution for IES' needs.

The MOU was signed by Mr Chow Kok Wah, Programme Director, IESA, and Mr Adrian Yeo, Chair, Digitalisation Task Force, SWA. It was witnessed by Er. Chong Kee Sen, Chairman, IESA Board, and Mr Chew Men Leong, President, SWA.

IES looks forward to working with both SWA and KPEA to benefit engineers and engineers-in-training, and to strengthen the engineering community globally in the years to come.

Present at the MOU signing on 18 April were (from left): Mr Chew Men Leong, President, SWA; Mr Adrian Yeo, Chair, Digitalisation Task Force, SWA; Mr Chow Kok Wah, Programme Director, IESA, and Er. Chong Kee Sen, Chairman, IESA Board.

The 1 April MOU was signed by IES Deputy President Dalson Chung (left) and KPEA President Dr Joo Seong-ho.

THE HEART & VOICE OF ENGINEERS

IES Membership

1) Professional Development

- Eligible for Chartered Engineers Certification Application (subject to registration criteria and conditions)
- Enjoy preferential rates for IES conferences, seminars and workshops
- Enjoy 10% to 15% discount for IES Academy Courses (T&Cs apply)

2) International Affiliations

- Interaction with overseas engineering institutions in joint programmes

3) Networking

- Exclusive FREE Members' Night (T&Cs apply)
- Enjoy preferential rates for networking activities
- Join our Sports Interest Groups
- Join our Social Events

4) Communication

- Enjoy free subscription of IES weekly e-Newsletter
- Free monthly e-zine – The Singapore Engineer
- Free Annual IES Directory containing the business contacts of all members
- Get the latest updates on government regulations and the activities of allied institutions

5) Others

- Enjoy special rate for IES professional Indemnity Insurance Schemes
- Enjoy exclusive merchant benefits
- Free parking in IES premises
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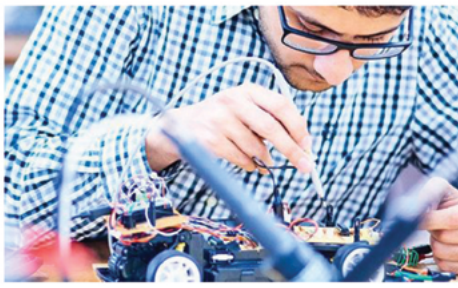

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